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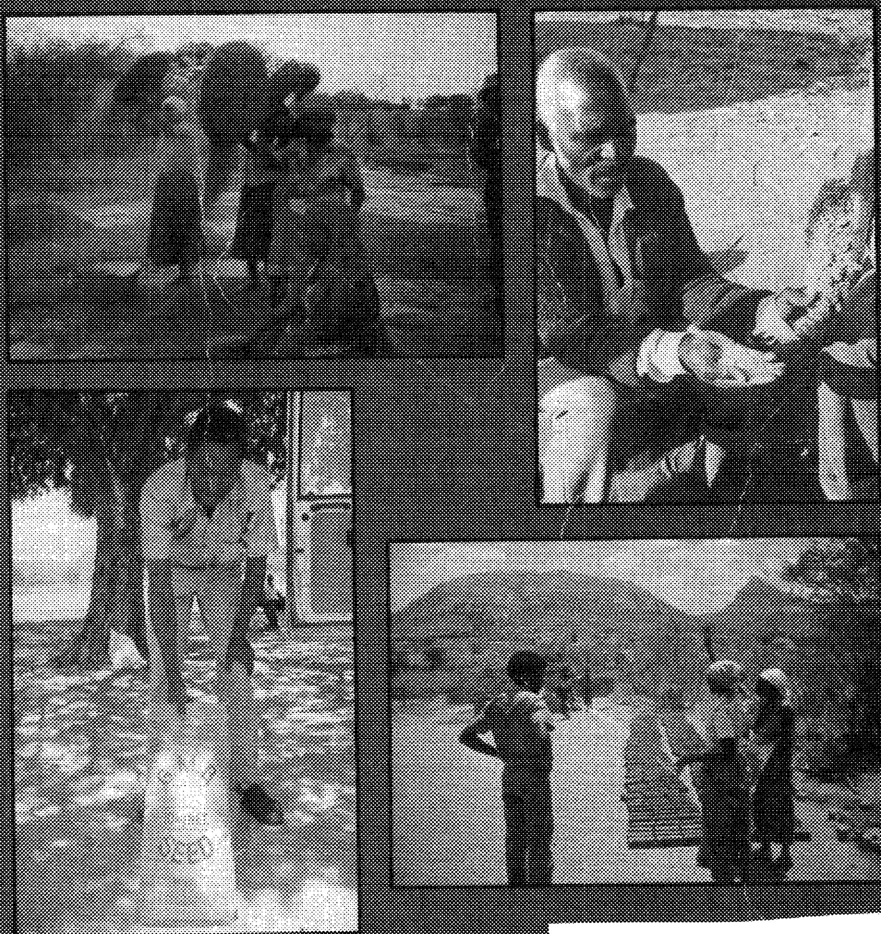
THERN AFRICA: OOD SECURITY POLICY OPTIONS



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University of Zimbabwe / UZ/MSU Food Research in Southern Africa

PN-ABC-214

SOUTHERN AFRICA: FOOD SECURITY POLICY OPTIONS

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FOREWORD

Throughout the SADCC region, policy makers require research results that can be used to design and implement policies that will improve food security in their countries. The objectives of the food security research project is to contribute to strengthening the regional knowledge base by conducting policy relevant research. In implementing this research, the project provides training for young researchers to strengthen their research skills; holds seminars and workshops; and publishes working papers reporting initial findings.

The annual conference provides an opportunity for the collaborating researchers to present their findings, receive feedback from policy makers and government official as a basis for identifying future research priorities, and to stimulate debate on food security policy issues. This proceedings contains revised versions of research papers prepared under the sponsorship of University of Zimbabwe/Michigan State University (UZ/MSU) Food Security Research Project in Southern Africa and presented at the University of Zimbabwe's Third Annual Conference on Food Security Research in Southern Africa, held at the Holiday Inn, Harare, November 1-5, 1987.

The papers included in this volume address critical food security issues in Southern Africa, organised around six themes. In the *Official Opening*, Professor W.J. Kamba, Vice-Chancellor of the University of Zimbabwe, highlights issues in building research capacity in SADCC universities. Representing the Ministry of Lands, Agriculture, and Rural Resettlement, Dr. Sam Muchena provides an overview of the challenges and accomplishments of SADCC's Food Security Programme.

The second section of the proceedings--*SADCC'S Food Security Programme*--presents an update on the current activities of the regional Food Security Programme; including papers on the early warning system, the inventory of agricultural resource bases, postproduction activities, and the regional grain reserve.

The third section--*Market Liberalisation and Food Security*--reports on research that analyses the history and impact of market liberalisation in Tanzania, Malawi, Zimbabwe, and Mali.

The fourth section--*Household Food Security in Sorghum Based Farming Systems in the SADCC Region*--includes papers by social and biological scientists that report on issues in designing household level food security research, traditional strategies for coping with food security, the state of the art for sorghum research in communal areas, the history and characteristics of food insecurity in two communal areas in Zimbabwe, and the implications of farming systems research in Botswana and Northern Nigeria for household food insecurity.

The fifth section--*Access to Food*--includes papers that analyse the role of the Government of Botswana in increasing rural and urban access to food, and the role of nonfarm activities in the rural economy.

The sixth section--*Communal Maize Production, Storage, and Marketing in Zimbabwe*--reports on analysis of the factors responsible for the rapid increase in maize production since independence, and the policy implication of household grain marketing and storage decisions.

The seventh section--*Wheat Production and Imports in the SADCC Region, What are the Tradeoffs?*--includes papers that provide insights into the political economy of wheat production and consumption in Sub-Saharan Africa, the economics of expanding wheat production in Zimbabwe, and the comparative advantage and policy incentives for wheat production in Zimbabawe.

The final section--*Food Trade and Food Aid in the SADCC Region*--includes papers that give an overview of grain trade, barter and triangular trade in the SADCC region; and agricultural marketing and trade policies with a potential to promote food security. In addition, these papers propose research needed to better understand trade policy issues and constraints to expanding intraregional trade.

As the breath of the papers presented at the conference suggests, the Food Security Research Project views food security as much more than simply expanding food production. Food security will only be achieved when all households have the ability to acquire a calorie-adequate diet throughout the year. Improving food security involves two interrelated components: increasing the national availability of food through production, storage, and trade; and increasing household access to food through greater access to production resources, income (from the sale of agricultural products, off-farm work, and nonfarm activities) and government transfers. Therefore, to improve household food security, research needs to address not only micro level issues, but also to evaluate the overall policy environment to determine its impact on producer incentives and the distribution of the benefits of development.

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ACKNOWLEDGEMENTS

This proceedings of the Third Annual Conference on Food Security Research in Southern Africa is the product of close cooperation between social scientists, technical scientists, government officers, and donor agencies in Southern Africa. The studies reported in the proceedings are part of a comparative analysis of food security in Sub-Saharan Africa that is directed by Michael Weber of Michigan State University's Department of Agricultural Economics. The UZ/MSU food security research programme is being carried out through a sub-contract with Michigan State University.

In the Ministry of Lands, Agriculture, and Rural Resettlement, we acknowledge the generous support provided by Sam Muchena and John Dhliwayo who are responsible for the close collaboration between the food security research project and the SADCC Food Security Technical and Administrative Unit--responsible for developing and managing SADCC's Food Security Programme. They have been particularly helpful in identifying relevant research themes that complement the SADCC programme.

The research supporting the preparation the proceedings papers was financed by the U.S. Agency for International Development, Bureau of Science and Technology; Bureau for Africa; and the Southern Africa Regional Programme; under a *Food Security in Africa* cooperative agreement (DAN-1190-A-00-4092-00) with the Department of Agricultural Economics, Michigan State University and a sub-contract with the Department of Agricultural Economics and Extension, University of Zimbabwe. We are grateful to the following present and former USAID officials for their support to the project's efforts to strengthen indigenous research capacity for food security policy research: Don Anderson, Curt Reintsma, Thomas Mehen, Calvin Martin, David Atwood, Ernesto Lucas, Michael Yates, Roy Stacy, Dale Pfeiffer, Pamela Hussey, and Janet Schulman. We are particularly appreciative of the support provided by Allison Herrick, Eric Witt and Joshua Mushauri of the Southern Africa Regional Programme, Harare.

We convey special thanks to Thembi Sibanda for an excellent job in organizing the Third Annual Conference, and to the many individuals who helped to make the conference a success: Murie Hutchison, Lovemore Nyabako, Maxwell Chiwashira, Samson Maguhudze, George Nyamatemba, Ronald Sagwete, Pete Hopkins, and Andrew Barnes.

We are especially indebted to Mrs. Corinne Smith for her patience, skill, and dedication in word processing the numerous drafts of the chapters included in this proceedings. Her persistence in mastering the word processing and laser printer technology has been exceptional.

Finally, we thank Chris Wolf and Elizabeth Bartilson for providing technical support for the laser printing technology used to print the proceedings.

OFFICIAL OPENING

BUILDING RESEARCH CAPACITY AND COOPERATION IN SADCC UNIVERSITIES

Professor W.J. Kamba[1]

It is with pleasure that I come here this morning to open the Third University of Zimbabwe Annual Conference on Food Security Research in Southern Africa.

But let me begin by welcoming those of you who are coming from outside our borders. Most of you come from our sister members of the SADCC. Others come from beyond the SADCC region and are here because of your primary interest and involvement with developments in the region. I wish you all a pleasant stay in Zimbabwe and in Harare.

Mr Chairman, the venue of the conference is the Harare Holiday Inn and the Faculty of Agriculture convened the conference. It is my hope that the choice of the venue will, in no way, influence our visitors into thinking that the Faculty of Agriculture does not welcome visitors on its own premises on campus! I also hope that you will find time to visit the faculty and the university before you leave.

PROBLEMS IN BUILDING RESEARCH CAPACITY IN AFRICA

The major preoccupation during post-independence Africa has been with political and economic cooperation. Unfortunately, such efforts have not been matched with intellectual cooperation to achieve the technological and socioeconomic transformation of our societies. The idea of building up research capacity and cooperation is one concrete way of achieving intellectual and technological self-reliance.

Before we turn our attention to strengthening research capacity in SADCC universities, we need to examine the problem from a certain perspective. It will be instructive if we pose the following questions:

- o What is the stock of science and technology manpower per million people in various African countries?
- o How does Africa's stock of human capital compare with Asia and Latin America?
- o What percentage of our science and technology positions are filled by expatriates?

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[1]Vice-Chancellor, University of Zimbabwe.

- o Where are the African scientists being trained, in Africa or in industrial counties?

The following statistics suggest that Africa faces a number of formidable problems in increasing its scientific capacity:

- o In 1980, Africa had one-fourth the number of scientists per million people that Asia possesses.
- o The number of Frenchmen in the Ivory Coast is estimated to be around 50,000 or four times the number at independence in 1960.
- o In 1984, expatriates accounted for one-fourth of the professional staff in research and extension services, agricultural schools, and faculties of agriculture in the nine SADCC countries.

From these statistics, one overarching conclusion emerges. Although African universities have made a large contribution to training manpower to Africanise the civil service and to provide staff for nonscience departments in these universities, we must face up to the fact that most of our faculties of agriculture are underfunded and are performing routine B.Sc. training functions. Moreover, some of our faculties of agriculture are isolated from the mainstream of government policy debates and are performing ad hoc research tasks.

Africa is a continent of technical assistance par excellence! For example, several years ago it was reported that there were about 12,000 expatriates in Kenya. Although technical assistance is theoretically attractive, in practice it can become a self-perpetuating exercise unless certain structural problems are addressed. For instance, what are cost effective ways to strengthen postgraduate training and research in SADCC universities in order to phase out technical assistance in a responsible and orderly fashion?

Despite the generous provision of technical assistance to SADCC member states and universities, I am convinced that a careful cost-benefit analysis would reveal that many of the benefits of technical assistance are unwittingly accruing to donor countries. To illustrate this basic point, let me cite a distinguished political economist from the University of Toronto, Gerald Helleiner. Professor Helleiner recently commented on technical assistance as follows:

> A succession of expatriates learn more and more about developmental decision making while the Africans below them in the hierarchy become progressively more alienated and discontented. The experience and collective "memory" which is accumulated during the process of development is thus appropriated by foreigners who subsequently leave the country carrying these invaluable assets with them.

I would like to support Professor Helleniner's observation and request donors to help us help ourselves by reducing our dependency on technical assistance. To date, we observe that international foundations and donors have opted to pursue a piecemeal approach to strengthening research and postgraduate training in our SADCC universities. We observe that donors prefer to finance discrete short term projects rather than making long term commitments to strengthening scientific capacity over a 10 to 20 year period.

I am delighted to note that representatives from 10 international foundations and donor organizations are participating in this conference: Ford Foundation, Rockefeller Foundation, Australian High Commission, World Bank, FAO, EEC, Canadian High Commission, NORAD, African Development Bank and the U.S. Agency for International Development. I hope that participants from these organizations will assist SADCC in developing long term programmes to strengthen postgraduate training and research in the region.

ROLE OF THE UNIVERSITY

Mr. Chairman, universities have three primary functions:

- o the dissemination of knowledge through teaching;
- o the advancement of knowledge through research; and
- o the extension of knowledge to society at large through seminars, publications, and conferences such as this Third Annual Conference on Food Security Research in Southern Africa.

With these functions in mind, we need to ask ourselves what universities have to do to ensure that they are responsive to emerging national and regional problems, and that they are efficient, cost-effective and active partners in the struggle for national and regional development.

We know that national and regional development is a complex process. We realize that the problems facing Africa, such as lagging food production and inefficient transportation go beyond our national boundaries. It is therefore our inherent duty to create a climate of debate on how to tackle problems facing our region that transcend space and time. It is also imperative that universities in the region pool their resources to develop cost-efficient postgraduate teaching and research programmes.

It was with this prime goal that a historic workshop on international university cooperation in East and Southern Africa was convened in Harare by the vice-chancellors from East and Southern Africa in June of 1984. At that workshop, a number of issues were discussed. The vice-chancellors agreed to:

- o form a corporate body to be known as the Association of Eastern and Southern African Universities; and o promote programmes consisting of the exchange of staff, students and external examiners; staff development; the strengthening of postgraduate teaching and research; and the execution of joint research projects.

ONGOING UNIVERSITY OF ZIMBABWE EFFORTS

The question therefore, is to strengthen postgraduate research and training capacity in the SADCC region. The University of Zimbabwe is giving high priority to developing this capacity in a number of ways. I would like to cite two examples of activities that are being carried out by our Faculty of Agriculture to strengthen agriculture research capacity in the region. The first example is farming systems research. The University of Zimbabwe Faculty of Agriculture, in cooperation with CIMMYT has developed several innovative training programmes in farming systems research to strengthen national agricultural research services and help our research and extension services speed up the flow of improved technology for small-holder agriculture. Since 1983, the University of Zimbabwe and CIMMYT have sponsored farming systems workshops for 300 researchers from 13 countries in Eastern and Southern Africa.

The second example is food security research. The University of Zimbabwe and Michigan State University are cooperating with SADCC in developing a food security research programme to complement the food security studies being carried out by SADCC member states. The University of Zimbabwe and Michigan State University are now in the third year of their cooperative research programme on food security. At last year's annual conference there were several discussions on the need to expand the research agenda and to secure the involvement of other universities in the SADCC region. I am delighted to report that the University of Zimbabwe is cooperating with researchers from the University of Dar es Salaam, the University of Botswana, and the University of Malawi. The second day of this conference is, in fact, devoted to reporting the initial research results that are emerging from this inter-university cooperation.

It is my sincere hope that your deliberations in this conference will be even more fruitful than the two previous annual conferences.

I declare the conference officially open.

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SADCC'S FOOD SECURITY ACCOMPLISHMENTS AND CHALLENGES

S.G. Muchena[1]

Mr. Chairman, honorable delegates, I would also like to welcome all of you, especially those who have travelled long distances to Zimbabwe.

We are encouraged at the prospect of this unique conference which brings together an outstanding group of experts and policy makers from the SADCC region and beyond to focus on food security research in Southern Africa. The University of Zimbabwe and Michigan State University are to be congratulated for this important initiative which has grown from strength to strength over the past few years.

Before discussing the food security accomplishments and challenges, I would like you to note one challenge I face today. About a week ago I was told that Dr. Simba Makoni would not be able to come and fulfil his commitment to present a paper to you this morning. I was therefore asked to present a paper in his place. Those of you who know how very articulate and eloquent Dr. Makoni is can appreciate the challenge before me. This is further exacerbated by having to share a session with a speaker of the calibre of Professor Kamba.

SADCC'S FOOD SECURITY PRIORITIES

It is a well known fact that SADCC assigns the highest priority to food and agricultural development. The tasks before us are great. Not only must we organize to increase food production, storage, and processing, but we are also challenged to provide greater access to basic nutrition for all segments of the populations. We are challenged to increase income and employment-generating projects in the rural areas. Such projects include crops, small-scale industry, and generation of raw materials for processing. As enunciated in SADCC's *Policy and Strategy for Food Agriculture and Natural Resources* document, income and employment generation projects are essential components for increasing national food security.

In point form, the principal elements of our food security programme are the:

o development of mechanisms for the exchange of information;

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[1]Deputy Secretary, Ministry of Lands, Agriculture, and Rural Resettlement.

- o reinforcement of national food production capacity;
- o development of intraregional trade in food and other crops;
- o improvement of the food storage, delivery, conservation, and processing;
- o development of cash crops and other agricultural enterprises;
- o establishment of systems for the preventic of food crises;
- o establishment of programmes for the control of major crop pests and diseases;
- o development of skilled manpower; and
- o development of mechanisms to facilitate the availability of appropriate production inputs from within the region and outside.

PROGRAMME IMPLEMENTATION

The current food security programme is being implemented through 13 interlinked regional projects and a series of other projects which, though national in character, when taken together contribute significantly to achieving SADCC's overall food security objectives.

Activities to increase food availability through expanded domestic production, reduction of postharvest losses, improvements in grain handling and storage, the enhancement of intraregional grain trade, and the development of an early warning system for food security have thus far produced the following seven programmes and projects.

- o The development of a cassava processing project in Angola. Funding for the implementation of this project has been secured.
- o A programme to improve small grains utilization in Botswana, Tanzania, and Zimbabwe is being implemented in close collaboration with SACCAR. Similar projects are being developed in Zambia, Lesotho, and Malawi.
- o Oil extraction projects are being developed for Zambia, Tanzania, and Zimbabwe.
- o A programme for household production of weaning foods using germinated cereal seeds is being developed for Tanzania, Zambia, Zimbabwe, and Lesotho.
- o A programme to enhance vegetable and fruit production in the region has been developed in collaboration with SACCAR and submitted to donors for funding.
- o Programmes directed at more efficient rangeland management and establishment of a regional soil fertility analysis service are being developed. It is envisaged this will lead to a number of specific national and regional projects for implementation.

- Three training workshops for silo operators and food handlers in Lesotho and Botswana; and a project to rehabilitate grain silos and to improve food marketing systems in Swaziland are being developed.

Some of these programmes and projects are discussed in more detail by my colleagues during this conference. I would like to touch on a few projects that my colleagues may not cover.

Regional seed production and supply

This study will analyze production, availability, and demand for improved seeds of the major food crops in member states; propose actions to alleviate constraints; and make recommendations on future regional cooperation in the sector. Following completion by mid-1988, a number of projects will be submitted to donors for funding.

Improved irrigation in the SADCC region

This study will identify how SADCC can improve regional food security through more effective exploitation of the region's extensive irrigation potential. The study will propose a strategy and programme of activities in the irrigation sector for implementation through the SADCC programme of action.

Strengthening and coordination of migrant pest control

The objective is to improve the regions' capability to protect crops against damage caused by migrant pests such as army worm and locusts. It is anticipated that a 12 month pre-implementation programme will commence in early 1988.

CHALLENGES IN IMPLEMENTING THE SADCC PROGRAMME

While the economies of member states are open and integrated into the world economy, trade within the SADCC region is extremely small. This is partly because of product similarity, but mainly because of the low level of industrialization and marketing problems--especially constraints on currency exchange between member states--and inadequate transport facilities. For example, recorded intra-SADCC trade accounted for about 5% of the SADCC countries' total imports in 1982. On the other hand, the SADCC countries' trade with South Africa is considerably higher, representing 7% of their total exports and 30% of their imports.

Over the past decade, the performance of agriculture in most SADCC states has been unsatisfactory. This poor performance has been part of an Africa-wide downward trend for three decades. For example, because the rate of population growth exceeded the annual rate of increase in agricultural production, the annual per capita growth rate of agricultural production was negative (-0.31%) for the last 35 years. Furthermore, because of drought, destabilization, and other factors; the annual per capita growth rate of food production in the SADCC region fell to -1.2% from 1970 to 1984. This average growth rate is heavily influenced by Mozambique's and Angola's negative annual growth rates of -4% and -2.9%, respectively.

The decline in per capita food production has been offset by steadily increasing cereal imports which, for the region (including Namibia), grew at an annual rate of 6.9% from 1970 to 1984--reaching 2.09 million tonnes in 1984-85. This has occurred even though Malawi and Zimbabwe reduced imports and have exported substantial quantities of cereals. Food aid to the region has doubled in the period 1980-81 to 1986-87 to reach about one million tonnes per annum.

I would say the greatest challenge we have before us is how to reverse the downward trends in per capita food production, thus reducing the ever increasing burden of food imports to this region.

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SADCC'S FOOD SECURITY PROGRAMME

SADCC'S EARLY WARNING SYSTEM FOR FOOD SECURITY

A. Todorov and T. Ngara[1]

BACKGROUND AND JUSTIFICATION

At the SADCC summit meeting held in Lusaka in 1980, the Zimbabwe government was charged with the task of formulating a food security plan for the nine SADCC member states: Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, and Zimbabwe. At the Maputo SADCC meeting of the same year, proposals and projects put forward by Zimbabwe were accepted, including a proposal to establish an early warning system for food security. In 1982, a FAO feasibility study recommended adopting Zimbabwe's proposal to set up a regional early warning system.

The level of food production in the SADCC countries fluctuates mainly due to national calamities such as recurrent droughts, floods, pests, and diseases. Timely information on the food supply situation for member states is an indispensable component for a regional food security scheme. Staple food crops included in the food security scheme are maize, sorghum, millet, wheat, pulses, cassava, and groundnuts. It is important that each SADCC country individually, as well as the SADCC region as a community, monitors the conditions of these food crops in the field and estimate both preharvest yields and production. By knowing in which parts of the country, or where in the SADCC region food deficits are likely to occur, or what surpluses are likely available for the market; the affected national or regional authorities can take appropriate measures well in advance. The importance of early indicators of the food supply situation is accentuated by the fact that six SADCC countries are landlocked. Therefore, they need more lead time than coastal countries to arrange for imports to meet food shortages.

Before national early warning units were established in all SADCC member states, some degree of crop monitoring existed in several SADCC countries. The only countries with relatively well developed early warning systems were Tanzania, Zambia, and Botswana. In these countries, early warning activities were executed by FAO through trust fund arrangements. However, there is considerable room for improvement in all SADCC early warning systems. Furthermore, the existing activities differed significantly from country to country, making common analysis for the SADCC region very difficult.

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[1]Project coordinators, SADCC Regional Warning System Project.

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SADCC's Regional Early Warning System Project (REWSP) was implemented in two stages. A one-year preparatory phase was followed by a three-year o erational phase. During the preparatory phase, the Regional Early Warning Unit (REWU) was established in Harare. National units for member states were established at different times, depending upon the availability of trained manpower and other necessary resources. For example, Tanzania has had a national early warning unit since 1978, Zambia since 1982, and Botswana since 1984. Most other SADCC member states have only recently established these units.

OBJECTIVES

The objectives of the Regional Early Warning Unit are to:

- o help establish national early warning units in SADCC states that did not have them;
- o advise and assist the national units in their operational work when required;
- o homogenize the methodologies and approaches used by the national early warning units and coordinate their activities;
- o organize training for the professional staff in the national units; and
- o provide SADCC with regional food security information based on data from the national units.

The long term objectives of the national units are to improve national food security by establishing a system which will provide advance information on crop production and food supply; and alert all those concerned well in advance of an impending food shortage or surplus, so that suitable and timely remedial action can be taken.

The immediate objectives of the national units are to:

- o coordinate early warning activities among government agencies;
- o improve objective measurement of crop area and yield and the collection of price, stock, import, and export data;
- o install a system for monitoring food crop conditions during the crop-growing season as well as for monitoring the general food situation in the country; and
- o train national counterpart staff on aspects of national early warning activities.

All data and information collected will be analysed and disseminated to the authorities through a variety of regular and occasional bulletins and reports such as:

- o periodic bulletins on crop conditions, soil moisture, storage, weather effects on agriculture, expected yield and production, etc.;

- o monthly reports on the food security situation in the country and the availability of agricultural inputs; and
- o technical reports as required by the government.

THE ROLE OF THE REGIONAL EARLY WARNING SYSTEM PROJECT

The REWSP plays a pivotal role in the galaxy of SADCC food security projects. It serves as a trigger mechanism for the Food Grain Reserve Project which will largely depend on information issued by the REWSP. Whether member states exploit these food reserves depends on the information obtained from the early warning system.

There is also a close link between this project and the Regional Information System (RIS). Food supply information originating from the early warning system will also be stored by the RIS. SADCC authorities will be responsible for further disseminating this information.

IMPLEMENTATION

Preparatory phase

The preparatory phase of the REWSP was funded by FAO under a technical cooperation programme. Its main functions were to lay the basis for an operational early warning system. This included preparing country project documents, recruiting SADCC and FAO personnel, purchasing computer equipment, carrying out early warning activities for Zimbabwe, reviewing methods used in crop forecasting in Zimbabwe, seeking extra funds for both the Angola early warning system and the REWU, discussing the signing and implementation of the early warning system's remote-sensing project, producing the first Regional Food Security Report in the wake of the 1986-87 drought, designing new infrastructure for Angola's early warning system, and carrying out a vital field experiment on soil moisture around Harare. Three training seminars for future national early warning unit staff (agricultural economists and agricultural meteorologists) were also conducted. Initial preparations for the 1988 and 1989 two-month courses in applications of agricultural economics and agricultural meteorology to early warning systems were started.

Operational phase (1986 to 1989)

The REWU collects information from the respective national early warning units.

During the crop growing season, the unit collects data for:

- o scientific analysis and interpretation of rainfall and other meteorological data and their effects on agriculture;

- o monitoring the state of food crops and food crop losses caused by adverse meteorological phenomena, pests, or diseases;
- o estimating the area planted to different food crops, yield, and production; and
- o estimating the amounts of grain to be retained by farmers and the amount expected to reach the market.

Throughout the entire year the national units:

- o monitor the existing stocks of major food crops, carryover requirements, and strategic reserves;
- o monitor grain consumption, deficits, and surpluses, and grain imports and exports;
- o monitor agricultural input use; including credit, seeds, fertilizers, pesticides, and fuel;
- o monitor farm-level prices, consumer food crop prices, and agricultural input prices;
- o monitor the progress of food procurement;
- o monitor the constraints to transporting and distributing food within the country; and
- o systematically collect, check, process, and analyse current and past data on agricultural, meteorological, economic, statistical, and social factors that affect crop production and food security.

Close links are maintained between the national units and the REWU in Harare to ensure that food security information flows both from the national to the regional unit and vice versa.

FUTURE PLANS

At the end of October 1987, the REWU convened a meeting of all nine SADCC member states in Harare. This meeting was attended by Danish International Development Agency and FAO representatives, and SADCC officials. The main purpose of this meeting was to discuss the operational framework of the REWSP. The main topics discussed were the national bulletin that each country will produce, channels of communication, institutional framework of the project, and the frequency and timeliness of regional and national food security bulletins.

The *Monthly Food Security Bulletin* contains both agroeconomic and agrometeorological data. Agroeconomic information includes area planted to different crops, inputs applied, estimated yield and production, population in need; and a food balance sheet showing opening stocks, estimated total consumption, carryover requirements, surpluses and deficits, targeted imports and exports, and closing stocks. Agrometeorological information includes rainfall amounts and distribution, a water satisfaction index based on FAO's methodology, reserves of available soil moisture, a satellite-derived vegetation index, the prevailing phase of crop development for different crops in each province, and pasture conditions.

To improve regional food analysis methods, a remote-sensing component will be introduced early next year. The remote-sensing project will strengthen the early warning system by establishing a satellite remote-sensing capability for monitoring precipitation and vegetation. Satellite data will help to more quickly and more accurately identify areas threatened by food crop failures and facilitate more timely reporting of this information to regional and national early warning programmes.

Furthermore, the project will develop techniques to assess precipitation and soil moisture, including necessary computer software. These efforts will be continued through the later stages of the project.

To modernize early warning system methods used in the region, the REWU will conduct a two-month course on agricultural economics and agricultural meteorology, as applied to early warning systems. These courses will be held in 1988 and 1989 during the dry season when there is less work in the national early warning systems. We will also sponsor study tours within the region so that staff from each SADCC country can benefit from contacts with their colleagues in other SADCC countries.

THE ROLE OF AGRICULTURAL RESOURCE BASE INVENTORIES IN NATIONAL AND REGIONAL PLANNING

M. Walsh, J. Samki, and H. Kamwendo[1]

INTRODUCTION

The Regional Inventory of Agricultural Resource Bases (RIARB) is one of several projects under SADCC's Food Security Programme. These closely-linked projects are designed to provide a comprehensive assessment of factors affecting agricultural production, food supply, and food security in the region. For example, the RIARB will inevitably develop strong connections with the Regional Resources Information System.

The RIARB is responsible for cataloguing physical resources at the regional level, drawing upon national inventories being established simultaneously. Therefore, the project will act as a catalyst to consolidate all land resource information at a single place at both the regional and national level. This paper discusses the concept underlying the regional inventory, its functional relationships with related national inventories, and the anticipated roles the inventories will play in national and regional planning.

INVENTORY OF REGIONAL RESOURCE BASES

Developing a regional inventory involves collecting, cataloguing, and presenting information about national agricultural resources, using a standardised approach to data gathering, classification, and presentation.

The agricultural resource base is the physical characteristics of the land, one of the basic factors of agricultural production. However, land consists of several elements such as the soil, climate, landform, and vegetation. In addition, it includes several factors used to modify the naturally occurring conditions, such as water for irrigation or fertilisers to improve soil fertility. An agricultural resource base inventory includes information on several of these important aspects of the natural environment.

Objectives of the inventory

The objective of this project is to establish an agricultural resources inventory at both the national and regional level to:

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[1]Project coordinator, soil scientist, and land-use planner, respectively, Regional Inventory of National Agricultural Systems, SADCC.

- o assess the crop and livestock production potential, based largely on physical parameters such as climate, topography, and soil characteristics;
- o assess the population-supporting capacity and its impact on crop and livestock potentials;
- o construct both a SADCC land-use legend and land-use map and establish land utilisation types relevant to the SADCC region;
- o compile a SADCC soil map using common terms for all countries;
- o derive agroecological zones for interpreting crop suitability and crop production potential; and
- o propose projects for SADCC consideration which will fill data gaps identified through the above activities.

By comprehensively documenting SADCC's agricultural resource base, the inventory should assist the Food Security Programme to achieve its aims in widely differing environments in the region.

The inventory should assist regional agricultural policy makers to answer key questions such as:

- o Which crops can be grown?
- o Where can they be grown?
- o What yields can be expected?
- o What variation in yield might be expected from year to year?
- o How is land presently used?
- o How much land is available for further expansion of agricultural production?
- o What are the physical constraints limiting agricultural land-use?

Functions of an inventory

Although compiling an agricultural resource base inventory is justifiable in its own right as a stocktaking exercise, it is of most value if information collected is used effectively. Therefore, the function of an inventory is to ensure that appropriate information is readily available to guide natural resource management, planning, and research. This information must be timely, relevant, accurate, and easily accessible to the user.

In SADCC counties, there exists extensive but scattered information about the natural resource base. These data have resulted from various *ad hoc* research surveys and projects development activities. Thus, one aim of preparing an inventory of the agricultural resource base is to systematically compile and collate data so that relevant information is documented and accessible to planners and policy makers.

Efforts to prepare a regional inventory should also help stimulate greater coordination between scientists and planners, in terms of survey and research programmes. Natural resource data is used for a variety of purposes, such as:

- o storing and updating topographic and natural resource maps, which may be combined to produce land capability maps;
- o relating land-use and population to land capability to indicate population pressure;
- o assessing erosion hazards as determined by slope, land-use, vegetative cover, rainfall erosivity, and soil erodibility;
- o defining agroecological zones based on the total climatic environment, soil, and terrain characteristics;
- o determining the degree of environmental suitability for different crops, based on soils and climate characteristics;
- o comparing satellite images with mapped information to measure changes in vegetation, erosion, and green biomass over time; and
- o correlating mapped information with information gathered on the ground, such as comparing estimated crop area and yield data from crop-cutting experiments with remote-sensing estimates.

These uses of natural resource information can be made at the country level from national inventories. However, a regional inventory compiled from national inventories would provide the basis for a regional planning capability. Regional users require a broad overall assessment of environmental conditions, with less detail than is usually required at the national level, but with more detail than existing continental or global inventories provide.

Resource information must be presented in a standardised way throughout the region to allow direct comparisons of environmental conditions in different parts of the region, such as growing-season length, average annual rainfall, rainfall patterns (bimodal or unimodal), ruggedness of terrain, and vegetation. In the longer term, a regional inventory should assist to define the scope for regional cooperation in food security and to formulate policies to rationalise agricultural production as a means of achieving regional self-sufficiency. Planners should also use a regional inventory to help define priority areas for development projects and to select environmentally suitable projects. Standardised presentation of these data will enable planners to identify projects and to assess the region's potential for development as a whole.

While regional inventory data has a wide range of uses, this project is primarily concerned with the first stage of agricultural resource appraisal (i.e., establishing an inventory of the agricultural resource base by compiling and presenting basic resource data). In the future, planners will carry out the various interpretive and land-use planning procedures outlined above.

Data requirements for the inventories

The main entries required to compile regional and national inventories are:

- o topographic maps that are up to date, using a 1:1 million contoured base map;
- o climate data for each station, including average seasonal rainfall, average monthly rainfall, length of growing season, average annual temperature, average monthly maximum temperature, average monthly minimum temperature, rainfall and temperature on a pentad basis, and a description of each meteorological station using World Meteorological Organisation format;
- o national soils maps (1:1 million) according to the FAO/UNESCO legend;
- o agroecological information derived from soil, topographic, and climatic data, based on a common approach;
- o population maps showing population distribution and density, and estimates of the rate of population change;
- o land-use information indicating current land-use;
- o irrigation statistics documenting the extent and type of irrigation, and area with irrigation development potential;
- o fertiliser information on proven and estimated quantities of fertilisers used; and
- o livestock information indicating livestock distribution and density, and a map of tsetse distribution.

Additional natural resource data being compiled at the country level include information on range resources and carrying capacity, geology, surface and groundwater resources (especially availability for irrigation and livestock), landform/physiography, and information about areas of land degradation and soil erosion.

IMPLEMENTATION

Administrative arrangements

The RIARB is staffed by a team of specialists at the central coordinating unit. The unit includes an agroecologist (project coordinator), a soil scientist, and a land-use planner. In addition to its coordinating role, the unit has a technical function to correlate and standardise the data. The project operates primarily with existing state and parastatal bodies within the SADCC region and with related SADCC sectors and programmes.

Member states are responsible for preparing their data in an agreed standard manner. This function is undertaken by the technical liaison officer nominated by each country. He is the contact person for the project and has now been officially appointed by all of member states.

Contents of the existing inventory

The regional data, which the RIARB project is compiling and intends to make available, is derived from much more detailed data being compiled at the country level. The work is ongoing during this phase of the project. Below is a sketch of the present state of implementation at the regional level.

Maps

A catalogue of most maps which are produced in the region is virtually complete. Copies of most small-scale maps have been procured and catalogued.

Climate and soils

These data are being compiled and correlated and a SADCC soil legend is being prepared.

Agroecological zones

A preliminary review of agroecological assessments and a comparison with FAO's agroecological zone approach has been made.

Population

Total population, age, and geographic distribution; and rate of change data are available for most countries.

Irrigation

Statistics documenting the extent and type of irrigation and the potential for irrigation development are available on a limited basis for some countries.

Fertilisers

Limited data on proven and estimated quantities of fertilisers, in relation to the increasing requirements of the region, are available.

Livestock

Tabulations of livestock numbers, structure, and distribution are available for most countries. The overriding problem is the quality of the data. Some information on tsetse distribution and limited information on dip tank distribution are available.

In addition to the above, data are being compiled at the national level on range resources and carrying capacity; geology; surface and groundwater resources; landform/physiography; vegetation; and areas affected by soil erosion.

Methods used in compiling the inventory

Inventory units

Policy and decision makers find it easier to relate development programmes or ideas to well defined administrative units. Therefore, country level natural resource data will be compiled on the basis of administrative units, be they districts, regions, or provinces.

A well documented administrative unit will be chosen within each member country as a pilot area to determine the structure and workability of the inventory. In this way, the inventory will provide resource and socio-economic data, which are essential to many agricultural development projects and to interpretive procedures for determining agroecological areas/zones.

SADCC soil resources and land-use maps

The project will produce SADCC soil and land-use maps. The possibility of each country producing its share of these maps is being explored. The process for compiling the SADCC soil map will be finalised at a meeting scheduled for March 1988 in Harare.

Land-use mapping using satellite imagery

To provide an up to date assessment of land-use and land cover in the region, the RIARB project s procuring the most recent band 5 (0.5-0.6 UM) of Landsat MSS cloud-free scenes as a first step. Samples of Landsat TM and NOAA AVHRR will also be procured to allow for comparison and extrapolation of results. The information will be presented at a scale of 1:1 million which should allow easy integration of land-use data with agricultural, climatic, and soil data in order to assess land-use potential and suitability in the region.

Data base creation

As the inventory is established, a natural resource data base is created. The data in the inventory will be computerised to speed storage and retrieval and to facilitate updating. Correlation of the data is essential for this purpose.

The team coordinator, through the computer staff of the Agricultural Institute in Ireland, is reviewing suitable computer storage and retrieval systems for the inventory. Results of this review will be presented to the SADCC Food Security Programme and, if accepted, will be utilised for the regional inventory. The extension of the system to the national level will then be explored.

Systematic collection of the resource data will help to identify areas requiring further documentation or research. This will assist in initiating and formulating projects for SADCC's consideration.

Literature procurement
Key words which describe the RIARB project identified over 9,000 references for the region. The project has acquired these references and abstracts, has categorised them by discipline and by country, and is distributing them to the RIARB technical liaison officers in all member states.

Air photograph coverage
While member states possess considerable up to date air photo coverage, their dates and scales are variable. The central unit is aware that negatives for air photographic coverage of some member states are held outside the SADCC region. This deprives institutions and personnel within member states of ready access to a very valuable aid to planning research and development activities.

Visits to member states
Central unit staff make regular and occasional visits to member states. This helps to maintain close links between the regional and national inventories and to ensure a coordinated approach.

ROLE OF THE RIARB IN SADCC'S DEVELOPMENT: SOME OUTCOMES

Table 1 illustrates a declining trend between population and area. It is obvious that steps should be taken to strengthen national and regional land-use planning to support increasing population by increasing productivity per

Table 1. SADCC's population and area.[a]

Year	Population (000)	Hectares/person
1970	43,369	5.29
1980	60,466	3.79
1990	80,658	2.84
2000	107,481	2.13

[a]Total land area: 477,122,000 ha; potential rainfed agricultural area, 229,330,000 ha (IIMI, 1986).
Source: FAO (1985)

unit area. This will require adopting a satisfactory, relevant, and clear methodology for evaluating land and population support capacity.

A land resource inventory is fundamental to assessing crop and population potentials. At present the RIARB project views this in the form of land (mapping) units whose agroecological conditions have been quantitatively characterised. This ecological characterisation should enable planners to determine the suitability of the various land units for all existing and potential food crops in the region. This is the idealised final use of the inventory. At that stage, the information derived should be made available to regional and national policy makers so that regional agricultural production programmes can be devised which directly contribute towards achieving food self-sufficiency.

Development programmes

Establishing the inventory is an on going process. At the same time, the RIARB project's central unit staff are initiating distinct programmes directly related to the inventory. SADCC-wide studies in progress include assessments of:

- o the potential for rangeland livestock production in relation to inputs and environment;
- o the capacity to carry out routine soil fertility and plant analyses in relation to farmer requirements and standardisation of methods;
- o soil productivity to standardise crop production potentials in relation to inputs and environment;
- o basic agricultural statistics to help standardise data collection and reporting methods to facilitate comparisons between member countries and;
- o the socioeconomic potential of agricultural resources to provide planners and policy makers with realistic estimates.

For the first two areas, regional programmes are being compiled from discrete national projects, as outlined below.

<u>SADDC's rangeland programme</u>

Objectives. The objectives of the programme are to develop the regional rangeland resources and to increase livestock carrying capacity.

Description Despite the rising numbers of livestock, the region is increasingly becoming a net importer of livestock products. Both number of small-scale farmers and the total number of livestock which they manage are increasing. While livestock numbers are too great for the fodder base to sustain, there are also too few livestock to satisfy the requirements of all farmers. Thus, the rangeland is deteriorating and livestock nutritional levels are falling.

Several problems which urgently require solutions include:

- o low nutritive value and dry-matter yield during the dry season, across all climatic zones, due to lack of water and overstocking;
- o bush encroachment and intrusion of noxious plants, due to overstocking, indiscriminate cutting of trees, or uncontrolled burning;
- o insufficient availability and poor use of crop residues and supplementary feed, due to monocropping and inadequate integration of livestock into farming systems;
- o trypanosomiasis in the more humid parts of the region, due to inadequate control measures and the absence of trypanosomiasis-tolerant breeds;
- o erosion due to the degradation of the vegetative cover as a result of overgrazing;
- o poor grazing management, as a result of ill-defined accountability for communal rangelands; and
- o low livestock offtake, as a result of insufficient market and transportation facilities.

A number of technical and socioeconomic solutions to these problems have been proposed, including rangeland rehabilitation, improved rangeland management, improvement of livestock feed resources, easing constraints to increased livestock offtake, and improving community participation in range improvement.

Four regional programmes are designed to achieve the rangeland improvement objectives:

- o range inventory and monitoring of rehabilitation measures at three sites in each country with an area of approximately 1,000 km^2, each selected to represent the region's major rangeland resources;
- o integrated land-use planning and management in a number of communities and monitoring attitudes to integrated land-use;
- o a review of training needs for extension officers, planners, decision makers, and the broad spectrum of land-users; and
- o efforts to increase farmers' awareness of the need for rangeland conservation and improvement, and to establish accountability.

SADCC's soil fertility programme

Objectives. The objectives of the programme are to guide the efficient use of artificial fertiliser by improving the capacity and efficiency of soil laboratory and analysis services; and by meeting the current and projected demand for soil analyses.

Description. In the region, inorganic fertiliser is the largest single foreign exchange expenditure in agriculture. Of the 0.75 million metric tonnes consumed annually, over 80% is imported from outside the region. Therefore, the soil analysis services must be capable of quickly and efficiently meeting the present and growing future demand, and be able to monitor soil fertility trends--particularly in intensively cultivated areas with high rural population densities. The latter would assist in the planning and developing the fertiliser industry.

An efficient soil fertility service plays a significant role in proper soil management. Several constraints have already been identified, including the need to improve soil sampling services, fertiliser recommendations and research backup, staff development, and the availability of facilities, equipment, and chemicals.

The proposed regional programme to achieve these objectives includes:

- o establishing proper soil sampling techniques by training and through mass media communication;
- o maintaining adequate applied-research backup for fertiliser recommendation;
- o providing farmers access to fertiliser;
- o modernising equipment in some of the services and providing adequate facilities and chemicals;
- o providing adequate budgets for running and maintaining the analysis service;
- o identifying and establishing training facilities for staff at all levels and possibly Portuguese and English-language courses to facilitate better communication within the region; and
- o arranging short term exchange visits of staff between the analysis services.

As part of the programme in Zimbabwe, the RIARB project is establishing a unique microcomputer link-up with the Soil Fertility Service and the Planning Department of AGRITEX (the extension service). This will help the Soil Fertility Service keep long term records necessary to evaluate gradual changes in crop yields associated with soil fertility and fertiliser application and composition. These data will enable the Planning Department and other sections of AGRITEX to monitor soil fertility trends throughout the country and use this information to develop farmer recommendations. In addition, this information will be of indirect use to the fertiliser industry to plan the production and distribution of its products.

The link-up will assist the RIARB project to assess regional crop production in terms of fertiliser inputs and help to estimate fertiliser requirements as a result of population increases.

FUTURE DEVELOPMENTS

As the present phase of the project is being implemented, distinct complimentary programmes are being initiated. These programmes will be managed and sustained by the countries themselves, with the RIARB project possibly playing a coordinating role. The RIARB project hopes to initiate several more programmes through the cooperation of existing institutions and personnel. The agricultural resource base programmes will help to refine and orientate the data base to meet the needs of planners.

Phase I of the RIARB project is projected to last from four-to-five years. It emphasises the collection and evaluation of data to identify gaps. Also, the data will provide basic information needed to evaluate the region's natural resources and the potential for agricultural development. The RIARB project is about midway through Phase I and has already initiated some development programmes during the course of compiling the inventory.

Phase II will focus on the long term development and use of the inventory, after satisfying the minimum requirements. Information of a more transient nature (for example, land-use) will need to be updated each five-to-ten years. A central unit will probably be required to update the inventory by incorporating new and improved data, to continue to evaluate the region's natural resources, and to promote use of the information by planners.

Provided the facility continues to exist, countries should be encouraged to submit more detailed information. Information obtained from systematic surveys is particularly valuable. For example, semidetailed and detailed soil survey data used to compile national inventories could readily be incorporated into a computerised data base.

In summary, possible Phase II activities include:

- o initiating relevant development programmes;
- o updating, expanding, and computerizing the data bank;
- o analysing, evaluating, and interpreting the data; and
- o developing analytical techniques for regional planning.

CONCLUSION

The chief aim of the RIARB project is to assist the SADCC Food Security Programme to achieve its objectives by providing a comprehensive information base required for agricultural planning. This consists of an inventory of land resources and interpretation in terms of the crop/farm system suitability of the region's agricultural resources. The inventory, which is partially constructed, has led SADCC to initiate two programmes vital to the development and management of two significant areas--soil fertility and rangeland management.

The agroecological conditions in the SADCC region provide an environment with enormous agricultural potential. The region can support about five times its present population at low input levels and about 12 times that at intermediate input levels (FAO, 1982). However, agroecological conditions in the region are varied and complex. Because of the large size of the region (about 5 million km^2), accurate and reliable data is often difficult and expensive to collect. Yet, collection and tabulation of relevant data is fundamental to agricultural planning. The assessments of agricultural production described above have all been conducted on a general scale and there is often insufficient experimental data to validate these estimates.

Maps representing agroecological conditions or zones at a 1:1 million scale are suitable for planning regional land-use and interpreting information at a high level of generalisation. Elements of the landscape which play a significant role in agricultural production, especially in drought years, cannot be shown. For example, dambos--low-lying seasonally waterlogged areas--while individually small, are collectively extensive in Zambia, Zimbabwe, and Malawi.

Thus, the RIARB is beginning to assess the agroecological conditions by tabulating these conditions on an administrative unit basis, with the flexibility to expand to smaller agricultural planning units. It should be stressed that when assessing agricultural production, the socioeconomic conditions in the planning units must also be considered.

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SADCC'S FOOD SECURITY PROGRAMME: FOOD PROCESSING AND PRESERVATION

A.C. Mosha[1]

INTRODUCTION

The Post-Production Food Industry Advisory Unit (PFIAU) was set up in 1984 to spearhead the implementation of projects under the SADCC Food Security Programme on food storage, processing, and preservation. In terms of the SADCC Food Security Programme, the projects examine various methods used in SADCC countries for reducing postproduction losses in major food crops; mainly cereals, grain legumes, vegetables, fruits, oilseeds, roots and tubers, livestock, and fish. Furthermore, existing food industry technologies are being studied with a view to promoting widespread adoption of those that are most appropriate within the SADCC region.

OBJECTIVES, CONSTRAINTS, STRATEGY, AND TACTICS

Objectives

The PFIAU has two main objectives:

- o to improve the efficiency and effectiveness of existing postproduction systems, food-processing industries, and technologies; and
- o to identify and recommend additional research, development and training facilities, and programmes to improve postproduction systems and food preservation processes.

Constraints

As a prerequisite for the PFIAU to assist member states in achieving the above objectives, the following constraints need to be addressed.

- o Policy makers in member states do not clearly perceive the benefits which will accrue to member states through their adoption of improved postproduction techniques and practices.
- o Agricultural policies must be broadened to embrace postproduction activities to compliment their present concentration on production.

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[1]Team leader and food technologist, Post-Production Food Industry Advisory Unit, SADCC.

o Inadequate numbers of suitably trained staff are assigned to postproduction research, development, and extension.

Strategy

The fundamental strategy of the PFIAU team has been to act as a catalyst in the postproduction sector of each SADCC member state and regionally.

Depending on the situation and experience in each country (which dictate operational priorities), the team acts to:

o focus national attention on postproduction problems, improvements, and opportunities so policy makers will initiate positive actions in the postproduction sector;

o strengthen existing formal training programmes for postproduction professionals and practitioners in the region;

o strengthen national postproduction programmes aimed at improving postproduction activities; and

o strengthen national and regional research approaches and on the ground development efforts aimed at improving the postproduction systems.

Tactics

To achieve the objectives detailed for each of the four strategies, the team has worked to establish a national postproduction systems committee in each member country and assist them to develop an effective action program.

Priority has been placed on strengthening postproduction systems of staple food crops--particularly those for which a national or regional improvement programme already exists; including food-processing industry components and preservation and processing at the rural, community, and farm-levels--often through existing national and regional institutions.

The team has contacted donors to gain their support for national postproduction training, research, and development activities. This tactic is necessary as present PFIAU funding only supports core activities. To have a significant and region-wide impact, considerably additional resources are needed. Consequently, the unit assists member states to prepare project proposals and solicit assistance from donors for their implementation.

ACTIVITIES OF THE UNIT

The PFIAU's strategy emphasises initiating catalyse action in the postproduction sector of each SADCC member state and regionally. Circumstances in each country has affected the number and type of actions initiated. In some cases, the project acted in areas markedly divergent from its intended focus on staple foods.

Focusing national attention on postproduction

Our principal activity in this area has been to establish national postproduction systems committees in all member states, except Mozambique and Angola. These two countries have chosen to establish a widely based working group under the aegis of a carrier organisation other than the ministry of agriculture or the ministry of internal trade. While these committees have been established and people have been nominated to serve as chairmen and members, they have mainly acted to arrange three national workshops on postproduction systems.

In the face of this situation, the unit established programme events in most countries such as trials, demonstrations, and training workshops. While these activities are catalytic, they will also gradually involve the committees.

The team has demonstrated the value of more extension orientated interventions for mobilising member state public services and other organisations, and will continue to use these methods.

Strengthening existing formal training

Specific interventions have involved training five silo depot managers from Swaziland and several food storage depot managers in Botswana.

The unit reviewed the Winrock report (1985) on training agricultural scientists for Southern Africa and the Gomez report (1983) on the food science training needs in the region. Subsequently, the unit proposed a manpower consultancy designed to measure the effective demand for postproduction skills in the region and the ability of training institutions to provide those skills. Due to circumstances beyond our control, the consultancy team cannot undertake this until 1988.

In addition, the team has established working relations with the University of Zimbabwe, Bunda College of Agriculture (Malawi), Sokoine University (Tanzania), University of Dar es Salaam, University of Botswana, University of Mozambique, University of Lesotho, and University of Swaziland.

Strengthening existing national postproduction activities

Most of our efforts have involved disseminating information, through personal contacts and publications. The PFIAU document collection includes over 1,500 publications. The unit has produced and distributed five newsletter editions. Unit staff have observed the initial rehabilitation of several large-scale food-handling plants in Tanzania, Zambia, Malawi, and Mozambique and is assisting those states, especially in training staff. The unit has established working relationships with the Commonwealth Agricultural Bureau International, ASEAN Food-Handling Bureau, IDRC's Information Sciences Division, and the National Free Library of Zimbabwe.

Strengthening national and regional approaches
Originally ranked last in our scheme, this fourth arena has become increasingly prominent. With the NPPS committees, we have identified intervention which are generating programmes for member nations and their committees.

The unit has developed good working relations with ENDA Zimbabwe, both in their grain storage enterprise and their sorghum-dehulling programme.

A cassava-processing development programme is underway in Angola and recently a similar proposal from Malawi was initiated.

A programme to improve sorghum and other small grains utalisation is being pursued in Tanzania, Zambia, Zimbabwe, Lesotho, Swaziland, and Malawi. This includes investigating traditional technologies to germinate and ferment weaning foods.

Soybean utilisation and processing are active features of our catalytic work in Zambia, Lesotho, and Malawi. Both oil extraction and flour production are involved, as well as the development of rich weaning foods.

Oil extraction from various oilseeds is being promoted in Malawi, Zambia, Tanzania, Angola, and Lesotho. A regional consultation will be held in November 1987 to map out a regional promotion strategy.

The unit is promoting the investigation of methods used by small-farmers to harvest, thresh, dry, store, and handle grain after harvest to identify appropriate existing technology or to develop suitable new technologies.

VISITS TO MEMBER STATES

Team members made 80 visits to SADCC states during 1985 and 1986. The visits demonstrated the value of specifying precise objectives before undertaking trips, without ignoring the value of serendipitous contacts and meetings. Team members found that visits to the hinterland of member states, away from capital cities and head offices, are particularly useful, although a blend must be maintained. Direct outcomes from these visits include the cassava-processing project being developed with Angola and projects on home level weaning food production in Zambia, Botswana, Tanzania, and Lesotho which are in various stages of implementation.

MAJOR RECOMMENDATIONS

The PFIAU held its first Broadening the Food Base Workshop in Botswana from April 13-17 April, 1987 which generated several recommendations.

Sorghum and other small grain dehulling
Participants identified promoting the wider utilisation of small grains, especially in the semiarid areas, as an important means of broadening the food

base and improving food security. This could be achieved by promoting mechanical-dehulling of small grains.

Composite flours

Participants agreed to investigate constraints to the commercial adoption of composite flours and recommend means whereby they can be overcome.

Weaning Foods

While improved weaning foods are technically available, they are not widely used. Participants agreed to test the acceptability of weaning foods made from germinated and fermented grains and promote their wider use.

In addition, they agreed to test the technical and economic viability of available small-scale oil expressing machinery and recommend suitable equipment for use in the region; assess the potential uses of oil expression by-products; and make suitable recommendations for each member state.

Training

Delegates requested PFIAU to assist national institutions with training in food science, either directly or through mobilising external assistance.

Coordination

Delegates insisted that making recommendations must go further than committing them to paper. They also recommended that PFIAU must undertake a brokerage role in the exchange of information amongst member states. Delegates agreed to provide information to the unit for this purpose and to contribute articles for the newsletter.

Consultancies

Professor Lee Fletcher was commissioned to undertake a study of the pricing systems of member states as a precursor to the marketing workshop held in November 1986. After he presented the report at our workshop and delegates made constructive criticism, it was accepted and distributed to member states. A follow-up of his recommendations is underway.

Our experience with consultants has lead us to take far greater care in devising the objectives and terms of reference for future consultancies. As policy, we now require all consultants to submit their curriculum vitae and a selection of their publications or reports in support of their bid. In the future, preference will be given to qualified regional personnel for consultancies, including commissioning resources people for workshops and seminars.

PUBLICATIONS

PFIAU has published numerous documents, including:

- five issues of the *Post-Production Systems Newsletter*;
- an *Annual Report* for 1985 and 1986;
- a brochure describing the structure and functions of the unit;
- proceedings of the 1986 and 1987 (in press) RTAC meeting;
- the proceedings of the five workshops;
- technical information sheets, prepared by our food-processing technologist, for inclusion in the forthcoming issues of the *Post-Production Systems Newsletter* and planned science and technology features.

The majority of these publications have emanated from the unit's staff, although some of the workshop papers have been further disseminated.

FUTURE PLANS

In the future, the units plans to complete the catalytic work on small grain-processing and products; and concentrate on soliciting funds to implement projects in the region.

The project will place priority on postproduction legumes and oilseeds systems since, together with cereals, they constitute the regional staple whose improvement will most enhance the populations' nutritional status.

In addition, the unit will give priority to processing and preservation of fruit and vegetables during the glut season. This will increase the dry season availability of these produce, providing access to more vitamins and minerals in the diet.

Eventually, the project will address processing and preservation of animal products--especially fish--using technologies applicable in rural areas.

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REVIEW OF GRAIN STORAGE AS AN ACTOR IN POST-PRODUCTION SYSTEMS IN SADCC

T. Rukuni[1]

INTRODUCTION

The demographic and economic structure of all SADCC member states is such that about 80% of their populations live in rural areas and earn their living from agriculture. Due to this economic and demographic structure, around 60% of the grain produced is retained on-farms for domestic consumption or local trading.

Governments of SADCC member states are seeking to improve food self-sufficiency. A greater availability of grain for sale to the formal market, over and above the requirements for retention, is seen as one of the consequences of improving productivity. However, there are often factors associated with the formal marketing system which militate against realising this objective.

CONSTRAINTS TO FORMAL MARKETING

In some instances, pricing policies provided inadequate motivation for farmers to sell in formal markets. They might be able to get higher prices through local sales or, in some cases, through cross border smuggling. For example, panterritorial pricing puts the more distant producers at a disadvantage.

In many cases, services offered by the formal market are weak. Depots are distant from producers, collections are infrequent, and payments are slow. Some organisations have inadequate physical and financial capacity to purchase all the grain offered.

Transport costs are often higher for more distant farmers, not merely because of their greater distances to be travelled, but also because of the paucity of transport infrastructure. Furthermore, the low availability of return loads increases the cost per tonne kilometer. Small or partial loads also increase the likelihood that farmers will pay excessive costs per tonne kilometer.

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Bags for packing crops are often in short supply or expensive, particularly in the more distant areas. Thus, forcing farmers to deliver their crops very late.

Combined, these factors make the returns which small-farmers (especially distant ones) can obtain from formal marketing unattractive. Consequently, households either produce less grain, or retain more on the farm in order to increase household food security by stockholding or by making local sales between seasons. This is a rational and economically sensible approach, whereby farmers seek to maximise the returns from their investment in crop production.

STORAGE OF GRAIN ON SMALL FARMS

One of the factors affecting small-farm storage arises from the successful drive towards greater productivity. There is now more grain to store, especially due to the unattractiveness of marketing surpluses, as noted above. Also, large, hybrid varieties are more difficult to store because they are softer than were their unimproved, lower-yielding predecessors.

Research results

Most of the research on improving small-farm grain storage in the SADCC region has involved trials and surveys to assess the magnitude of current losses. The results of this work have been highly variable; depending on the assessment methods, the quality of the work, and the seasons and areas sampled. Our crude estimates suggest that losses vary between 5% and 20%. This means that a maximum benefit of about 15% could be obtained from any effort to reduce losses. We must remember that the costs of reducing losses increase per percentage of loss as we approach the optimum.

The vast majority of the remaining work (i.e., other than loss assessment) has studied ways and means of improving grain stores. These results have not been successfully extended because farmers have (while researchers have not) concluded that the costs involved in creating the improved stores far outweigh the benefits of reducing losses from, for example, 15% to 5%. I agree with the farmers.

Economics of loss recovery

Because of the reasoning outlined above, the technically sound work to which the majority of postproduction loss reduction resources has been directed, has come to nought. There is a perceptual fault, common to many researchers (not just grain storage workers), which says that 10% of one million tonnes of grain is 100,000 tonnes. They then value this at Z$100 a tonne and set off to recover the Z$1,000,000 which the 10% loss represents.

I do not doubt the mathematics of their assumptions. What they have overlooked is that the majority of this grain is stored on-farms in lots of less than two tonnes. Each farmers' loss is about two bags, or Z$20. In this extension situation, the maximum increase in the income which the farmer derives from his grain is going to be Z$20, if none is lost. He and his family will probably be impressed if they can save one of the two bags. If the recommendations which you make to the farmers cost them more than Z$10 (cash or kind), they are unlikely to adopt them. Who, in his right mind would spend Z$15 to save a maximum of Z$20? This is not a good investment.

Looking at the problem from the farmers' point of view puts a different perspective on, for instance, concrete grain stores. How long will it take a farmer to show profit--in terms of grain saved--on an investment of Z$500 for a concrete store? If the maximum gain is Z$20 per year, 25 years are required.

I have gone into detail to set the scene for the grain store research so that extension workers will know what they are working with. The scene has also been set for the analysis which follows.

TRADITIONAL GRAIN STORAGE

The vast majority of grain stores used in the SADCC region are containers made from locally available materials, often imitating the shape and construction methods of houses. Technically, they are capable of storing grain efficiently, are cool, present physical barriers to pests (including thieves), and keep water out. In addition, since the people are familiar with their construction, little teaching is necessary. It is possible to improve store maintenance and management such that the traditional stores more nearly achieve their potential.

Reducing moisture content

It is important that grain put into store is at a suitably low moisture content. Farmers have only subjective methods to judge if grain is ready for storage; these include appearance, biting, and ease of shelling. What can be done to cheaply provide a more objective test? Moisture meters are manufactured in Zimbabwe (but in no other member state to my knowledge) and cost Z$550 each.

What can we recommend to farmers to ensure that the amount of foreign matter and pests going into the store with the grain are minimised? What are the costs and benefits of harvesting early and drying the cobs in cribs or of stacking on the ground? Do the termites eat enough to make crib-drying profitable?

Reducing insect damage

Shelling

Grain is rarely shelled before it is stored. The appearance of the larger grain borer has prompted extension workers to encourage farmers to shell their grain before putting it into the store. Shelling also increases the efficiency of chemical grain protection. If you store on the cob, you increase the amount of material being stored (regardless of the fact that the cobs and sheath are not eventually consumed). This increases the amount of chemicals needed to treat the grain and the storage space required.

Why do people resist storing shelled grain? Probably because of a labour bottleneck. To hand-shell two tonnes of grain for storage, in addition to shelling some for market sale, requires a lot of labour. Grain shelled for the market is obviously given preference as it brings in cash and there are often penalties for quality losses. Logistically, it is easier to throw unshelled grain on cobs into the store and to shell them as needed. What is needed to make storing unshelled grain technically acceptable? What is needed to remove the shelling bottleneck? Available mechanical shellers are either too expensive to buy or operate, while the hand-operated ones are only marginally more productive than hand-shelling.

Chemical control

Researchers have most thoroughly studied losses caused by insects. Chemicals used to control *sitophilus, sitrotroga*, and related species are malathion, pirimiphos methyl, methacrifos, tetrachlorinphos, and permethrin. Most member states have no monitoring, testing, or registration systems for these, or any other agricultural chemicals. Some farmers continue to use non-recommended chemicals such as DDT, which surely indicates something is amiss with the promotion of recommended chemicals. Trials show that the recommended chemicals do work, if applied correctly, and if they are not so old as to have lost their efficacy. How can the delivery and usage systems be improved?

CONCLUSION AND RECOMMENDATIONS

Whatever work is done must consider the target users and their circumstances. What will be the costs and benefits to the farmers and how long will it take them to garner the benefits of their investment?

There is a need to:

- o consider ways to improve the mechanisms and operations of the formal marketing system to make marketing more attractive to farmers;
- o devise cost-effective, perhaps indirect, indicators to show when losses cross the economic threshold;

- o develop means whereby farmers can objectively assess the moisture content of grain in a cost-effective way before storing it;
- o initiate operations research to investigate options for saving produce and cost in the whole system, from harvest through final consumption (or sale);
- o examine the labour bottleneck at shelling; Can grain be cost-effectively stored on the cob? If not, how can the productivity and cost-benefit relations of mechanical shelling be improved to remove the bottleneck?
- o make recommendations on the maintenance and management of traditional stores and extend these recommendations;
- o assess alternative materials for constructing stores in terms of efficacy, cost-benefit, and availability;
- o promote afforestation to reduce the principal constraint (i.e., wood shortage) to building more traditional stores;
- o improve the availability and usage of chemical protectants, both in terms of logistics on the supply side and extension to ensure correct usage;
- o initiate research to see if it is possible to cost-effectively obtain a high percentage insect kill before grain is stored; and
- o subject all existing recommendations and ongoing research to a farmer-orientated cost-benefit analysis before granting any further support.

I have sought in this paper to demystify the business of on-farm grain storage and to indicate to you where I believe efforts can be usefully directed, as well as the form in which they are needed. It is my belief that the usable answers to reducing on-farm grain storage losses in SADCC are largely known already. It is my belief that any programme to improve the grain storage system on small-farms in the SADCC region needs a small research input and much greater assistance to the extension component.

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THE SADCC REGIONAL FOOD RESERVE PROJECT

G.W.J. Almond, K.J.M. Dhliwayo, and F.H. Drane[1]

INTRODUCTION

Food security is achieved when people have access to sufficient staple foods to enable them to lead healthy working lives and participate in the growth and development of the societies in which they live.

In the present state of knowledge it is impossible to define precisely what constitutes sufficient staple food. The requirement varies widely among individuals, environments, and conditions--especially when people are under sustained nutritional stress. Nevertheless, nutritionists have broadly established the general requirement needed for reasonable health and activity. Access means more than just having available a supply of food. It also means the ability of a family to acquire (grow or buy) sufficient food to meet its perceived needs. Recent performance clearly indicates that the region as a whole has experienced deteriorating food security, although this deterioration is not uniform. Food security has improved markedly in some areas of the SADCC community, especially where household incomes have increased such as among emergent commercial farmers.

The regional initiative

While the full-scale achievement of food security for all the peoples of Southern Africa may be a long way off, the *Lusaka Accord* (1980) established that improved food security was an essential objective in the drive towards economic liberation. As its strategy, the *Accord* identified and called for giving priority to the possibility of coordinating national reserve policies and facilitating interstate exchanges.

Regional cooperation on food security was therefore one of the first concepts launched through SADCC when the Council of Ministers asked for the preparation of a plan of action at Maputo in November 1980. Responsibility for preparing and implementing the plan was given to the Government of Zimbabwe and its proposals were developed into a programme of nine complementary and interlocking food security projects (SADCC, 1982). These included the Regional Food Reserve and Food Aid projects.

SADCC's Regional Food Security Programme is directed at consolidating regional and international experience; strengthening cooperation in planning

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[1]Technical advisor, Sector Coordinator, and technical advisor, respectively, Food Security Technical and Administrative Unit, SADCC.

the use of resources between member states; and identifying and implementing projects and programmes which promote food security and expand intra-regional exchanges.

Trends in food security

During the 1970s, the general trends in population growth and food availability in the region indicated a worsening situation. Supply trends to 1983, as measured by production over the region as a whole, indicated that cereal yields had fallen to 85% of their mid-1970s level. Meanwhile, SADCC's population had increased by approximately 3% annually. At this rate, the region's population will double in less than 25 years. Although planted area has increased, output has only grown 1.5% per year. Analysing these figures, the Food and Agriculture Organisation (FAO) projected that, on the trend, the self-sufficiency of the region will decline from 95% in the period 1979-81 to 64% by the year 2000 (FAO, 1984). Even if the annual rate of farm productivity can be increased to 3% per annum (double the present rate), the region would still face a decline in self-sufficiency of domestic production.

Food security is therefore under continued threat as internal sources of supply are increasingly replaced by imports and food aid. Moreover, the increasing demand is mostly the result of population growth and disguises the uneven distribution of economic growth.

Pre-feasibility study of SADCC's Regional Food Reserve

As part of the Regional Food Security Programme, SADCC undertook a study in 1983 (Technosynesis S.P.A,, 1984) to examine the feasibility of developing physical stocks to act as a regional food reserve, primarily against supply fluctuation. It concluded that, when compared with the cumulative impact of calculated individual national food stock needs to cover the possible requirements, a regional food stock was cost-effective, economic, and desirable. As a result of this conclusion, the study recommended the construction and stocking of large, dispersed grain storage depots to be held under SADCC control.

After extensive consideration, the recommendations were not implemented, mainly on account of financial and political factors. The financial constraint was the difficulty in obtaining sufficient funding for construction, to acquire stocks, and to finance operating costs. Had funding been available, management of the substantial dispersed stocks called for supranational decision-making power. Taking into account the political nature of food security, this level of authority was unacceptable to the SADCC community.

The financial implication of the project is illustrated using 1986 cost estimates. Counting only direct costs, grain storage costs about US$30 per mt per year (The addition of indirect costs could well double this figure). Thus, the annual cost of storing one million mt is approximately US$30 million. In addition, the fact that the reserve would tie up US$100 million of capital in grain alone must also be taken into account. These sums may be contrasted with central government spending on agriculture by SADCC states (excluding Angola, Mozambique, and Lesotho) which averaged approximately US$360 million per year during the early 1980s.

CONSTRAINTS TO REGIONAL FOOD SECURITY

Food insecurity results from either the unavailability of sufficient food to meet the basic needs of the urban and rural populations, or the people who need it are unable to obtain it--even if it is available. Whether the scale is regional, national, local, or at the household level, the result is that people do not get enough to eat. Regardless of the reasons for food insecurity, the constraints and solutions are different at each level.

The first problem is that presently it is impossible to accurately calculate food requirement or demand. Not only is it difficult to precisely calculate the biological needs of an individual, but also calculating demand must take into account the influence of economic-purchasing power and want, as opposed to need. Many experiments, observations, and estimations of need have led to widely-ranging estimates of what constitutes security of supply. For the cereal component in the average diet, 186 kg of cereals per person per year was used in the preparatory work for this project[2]. This of course takes no account of the fact that some households are unable to pay for the needed cereals.

It is a fundamental duty of government to establish conditions under which sufficient supplies are made available, whether through domestic production or imports. Therefore, insufficient or unreliable production is the first constraint and imports must make up for deficits if this duty is to be discharged.

Constraints to supply

In Southern Africa, high rainfall variability ensures that staple food production will vary from year to year. This is illustrated by comparing the gross production per caput in SADCC. In 1986, a good year, the region produced

[2]The feasibility study for the Regional Food Reserve (Vakakis and Associates, 1987) settled a figure of 186 kg of cereals (wheat equivalent) per person per year for predominantly cereal-eating populations.

a gross output of 179 kg per person. Estimates made in June for the 1987 harvest, afflicted by the February drought, were 123 kg per person.

In spite of the success of some member states in achieving an exportable surplus, others remain deficient in basic food staples. This is because of major security problems, the package of technical inputs and incentives does not sufficiently attract the farmer, he cannot reach the market, or the natural resource base for food crop production is inadequate. These are all constraints on production. Some are temporary and can be removed, some cannot. There are large areas and communities which could become surplus producers of staple food crops, given adequate access to markets and appropriate policies regarding production techniques, inputs, and incentives.

Future prospects

At the regional level, available evidence suggests that through continued research, it should be possible to increase the food supply. Inherent cereal supply prospects are so good that, in areas which are now surplus, the future priority will shift from accelerating the growth in cereal production to stimulating or maintaining growth in incomes and employment in rural areas. This will require a planned diversification into noncereal crops and an increase in nonagricultural employment opportunities.

The problems of physical stocks

During the early 1980s, considerable international concern arose over food security, both in Africa and elsewhere. National supply sources were slashed by drought and other causes. Rural economies were setback, reducing home production and family income. The traditional approach--holding sufficient contingency reserves as physical stocks--was challenged by the resulting emergencies which were too demanding to be handled by contingency reserves as physical stocks. Stocks were seldom in the right place or in good condition when needed, resulting in costly overstocking. Large reserve stocks have an adverse impact on trade and the cost of maintaining large stocks sometimes proved to be an inefficient use of funds. At the same time, these stocks are more or less inaccessible to people without money, unless they are given away. Furthermore, subsidised local stocks (and food aid) are likely to depress local prices and therefore production. Moreover, it is politically difficult to maintain stocks of food as a reserve in areas of widespread food insecurity. Finally, since such areas are frequently poorly serviced and in unfavourable climatic zones, it is often technically difficult to maintain stocks in condition.

Constraints to access

The availability of food stocks does not necessarily mean that households will have access to the supply.

Trade

Even though surpluses and deficits within the region crudely balance, only 5% of all trade within the region involves food. A root cause of this situation is difficulties with the interstate exchange rates and the scarcity of foreign exchange. Even when fully financed externally as food aid, it is still difficult to implement these agreements on account of transport constraints. Nevertheless, it is evident that large opportunities exist to increase the volume of cereal trade within the region.

Moreover, because annual fluctuations in cereal production within the region as a whole are lower than for any single country, increased intraregional cereal trade offers an opportunity to reduce the costs of maintaining reserve stocks in surplus countries. Thus, increased trade in staples would enable all countries to reduce the level and costs of their national reserves.

This suggests that expanding trade, as stated in the *Lusaka Accord*, must become a major part of the regional food security strategy. It could both reduce food import costs and reduce the number of years during which SADCC countries would have to import food from the rest of the world.

Foreign exchange

At the national level, some states lack the resources to produce sufficient staple food. Such states must obtain foreign exchange to import the balance of their requirements. Other states are sometimes importers and sometimes exporters. Such states face the decision of how much may be spent to maintain stock levels and how much will be reserved to import in time of need. Any surplus will be traded. In such situations, foreign exchange (and therefore trade) is essential to food security to ensure an adequate supply for urban and deficit rural areas.

Declining subsistence production

At the subnational, village, and household levels, rural people must produce sufficient food to feed themselves, at least until households produce an economic surplus sufficient to finance local imports. However, most SADCC producers are subsistence based family farmers, due to slow development of the market economy. Coupled with growing population pressures and limited holding size, this has forced intensification of the traditional farming systems. Once intensified beyond a critical level, or stressed by drought, yields often decline rapidly.

Faced with growing population and decreasing availability of good quality land, food security can only be maintained by producing more through intensification, by earning more cash through increased market production, or through greater access to nonfarm employment. The essential need is to raise rural incomes.

Low rural incomes

To sustain economic development, markets for industrial products are needed. These markets must be found among the rural population. The many difficulties in raising rural incomes--insufficient marketable production, risks to changing subsistence management techniques, job creation, and divestment in times of drought--contribute to domestic food insecurity. Any food security project must contribute to overcoming these constraints.

Information

It is fundamental to national food security that food production and reserve policies are more readily and more economically made in the context of the plans and performance of neighbouring states within the community. Experiences can be shared and, where appropriate, technical assistance provided from regional resources.

RATIONAL FOR THE SADCC REGIONAL FOOD RESERVE PROJECT

On a subnational basis, a considerable part of the SADCC community's expanding population is no longer able to either secure its own food needs or find sufficient employment in either rural or urban labour markets. The trend is complicated by recurrent drought, war, and slow economic growth. The effects are reflected in the growing imports of staple foods and increasing dependence on food aid programmes. Commodity food aid often depresses local prices, making it difficult for small-scale farmers to recover and reinvest in order to produce a marketable surplus after, for example, a serious drought. The end result of the decline in home farm production is often increased migration off the land which swells the urban population. This trend in itself is a major constraint in African development and constitutes a fundamental food security problem. Once recognised, much can be done to avoid these negative aspects of food aid, while simultaneously taking advantage of the wealth transfer necessary to counterbalance the catastrophe.

Thus, even though it may actually contribute to the downward spiral of traditional farming systems under pressure, food aid is a vital tool to interrupt this trend. Resources put into providing food aid can be channelled towards supporting the local economy.

Given the regional potential for sufficient production, regional level constraints--such as stocking policies, scarcity of foreign exchange, and transport priorities--make it difficult to transfer surpluses. At the national level, appropriate policies are required to release the potential for economic production, marketable surpluses, and to expand rural employment. To minimise the economic costs of keeping reserve stocks, it is necessary to increase efforts to forecast both production and demand (Oxford, 1987). Efforts to increase the exchangeability of currencies within the region are both needed and welcomed.

The updated food security strategy

SADCC's current food security strategy takes account of these constraints and the changing food production situation in the region. It recognises that increasing food production and achieving national food self-sufficiency, *per se*, will not automatically end hunger and malnutrition. Therefore, the strategy aims to increase household, national, and regional food security by encouraging activities that will enhance the ability of all people to acquire an adequate diet.

The strategy reiterates the importance of increasing food production in food deficit member states where this can be done economically. It encourages crop diversification projects, especially for export crops, horticultural crops, dairy products, livestock production, and raw materials for industrial use where production of staple foods is insufficient or uneconomic--and projects to create employment. It also promotes rural small-scale agro-industries as a critical component to increasing off-farm employment.

Meanwhile, SADCC's need for food aid has been increasing steadily. While cooperating partners have generously supported food aid needs, progamming and delivery have been difficult to plan. Implementation has been haphazard and to some extent managed confidentially. These aspects have tended to make trading more difficult and obscured important issues.

The feasibility study

Following the decision not to implement the 1983 pre-feasibility study, a further study was undertaken to identify a more flexible and less costly solution, but one able to take advantage of the economic benefits of regional, as opposed to national food security programmes. This study (Vakakis *et al.*, 1987) reviewed levels of requirement for a regional food reserve and possible management alternatives, and developed detailed objectives and an implementation programme. SADCC's Regional Food Reserve Project (FRP) is being established on the basis of this feasibility study as part of the core of the Regional Food Security Programme.

PROJECT DESCRIPTION

Objectives of SADCC's Regional Food Reserve Project

The FRP is being set up as a focal point for mobilising resources needed to support a regionally based food security reserve facility. The resources of the FRP will be mainly financial, instead of conventional physical stocks. The facility has the immediate objective to increase trade in food grains between surplus and deficit member states within the SADCC community. The essential purpose is to alleviate food shortages in member states facing emergencies and unable to quickly assemble the food required or the foreign exchange to buy it. Also, the project has long term objectives in data gathering and project formulation to help member states improve long term food security.

The project also has a large parallel-training component. It will support technical and management training to improve storage and marketing, provide training in the distribution and use of food aid, and support workshops on food production and marketing policy.

The main objectives of the FRP are to:

- o provide a mechanism to enhance intraregional food trade;
- o establish a regional food reserve facility to enable quick response to natural calamities occurring in SADCC member states and to serve primarily as a buffer mechanism in the event of serious drought;
- o secure food supplies on optional forward purchase where appropriate;
- o assist member states in alleviating structural food shortages, including those cause by insufficient foreign exchange, and to stimulate increased food production within the region; and
- o provide support for training in grain storage, management, and distribution.

Project activities

To achieve these objectives, data must be collected and analysed to estimate demand on the resources of the FRP. Supplies must be identified and arrangements for transfer made, either directly or through the project's own resources. Resources to overcome the foreign exchange constraint must be identified and secured. Contracts will have to be drafted on behalf of cooperating partners supporting the project or finalised by the project itself. Prices must be established for forward purchases (emergency standby reserve) and negotiated for current purchases. In the event that demand on the facility exceeds the resources of the FRP, available resources will have to be allocated between beneficiaries. Deliveries will have to be arranged, paid for, and checked.

Simultaneously, the project must implement several development aspects. These activities include a sustained effort to improve trading conditions, establish the parallel-training components, analyses of problems encountered, and identification of long term food security projects at the household level. In addition, the FRP must effect its own training programme.

Project components

A Regional Food Reserve Board, to be established with a representative from each member state, will direct and monitor the project. The reserve management, consisting of a small management team within the Regional Food Security Programme's Food Security Technical and Administrative Unit (FSTAU) will conduct day to day operations. Additional components will include a parallel-training programme and the foodstuffs or commodities to be processed through the programme.

In its development of the project, SADCC has made it clear that the reserve should be able to function with all foodstuffs provided under food aid programmes. In defining food stuffs, it is necessary to take into account that:

- o the FRP intends to, where possible, use aid provided by the project to stimulate demand from within the region;
- o it will be difficult, at least initially, for the food reserve management to prepare supply and demand projections on a wide basis; and
- o funds or commodities provided by cooperating partners may be conditional.

Therefore, it is anticipated that the FRP will start up mainly using white maize. Subsequently, the food reserve management may become responsible for other commodities provided through triangular or other exchange mechanisms.

Size of the reserve

The amount of foodstuffs processed by the FRP in a given period will be a function of the demand by member states and the resources made available by SADCC's cooperating partners. However, it was necessary to calculate the indicative size of the reserve. This projection was based on the estimated maize required to provide vulnerable groups (under the World Food Programme's working definition) with a four-month buffer supply of food grains in the event of serious and region-wide drought.

It is estimated that the FRP will require a maximum of 356,000 mt in any one year during its three-year establishment period. It is evident that this maximum, determined by the buffer basis, is small--compared to the total food aid needs of the region. The project is not intended to supplant food aid previously provided under bilateral assistance. Moreover, it would be too ambitious for a new project with long term objectives to take on all the problems of war relief; and it does not attempt to do so. In view of the food aid requirements of the current season, it is hoped that the cooperating partners will, as far as possible, make their contributions to the project incremental to the aid they have already provided to the region.

The project, as approved by SADCC's Council of Ministers, will be established for a three-year initial phase as soon as funding can be assured for the management and training components. It is anticipated that the reserve function will become operational during 1988, subject to the support of SADCC's cooperating partners (Argentina has already committed grain). While it is intended that the FRP will become increasingly self-sustaining, funding for the initial three-year period will come almost entirely from external sources. At the end of its second year, the principles, experiences, and development needs of the FRP will be reviewed.

Project costs

Over the proposed three-year period required to establish the programme, an estimated US$209 million (1986 dollars) will be required for grain purchases and management (including board meetings, management staff, and operations; specific training; and appropriate technical assistance)--an average of US$ 68.7 million per year. This estimate includes funds to purchase 356,000 mt of maize per year. The cost of management over the three-year period is estimated at US$2.1 million, or 1% of the total estimated project costs. An indicative figure of US$2.7 million was included for the parallel-training programme, but this has yet to be confirmed by a pre-implementation study to be carried out during 1988. Costs for secondary distribution of grain supplied, time input by officials, and minor and incidental costs at conferences are not included in the estimate.

By the third year of the project, annual costs of operating the FRP are expected to stabilise at US$321,000 (1986 dollars). Subject to the favourable conclusions by member states on the midterm project review, it is expected that member states will begin to shoulder at least part of the FRP's management costs.

ORGANISATION AND MANAGEMENT

The FRP has been set up within SADCC's Regional Food Security Programme. The governing body of the FRP will be the SADCC Food Reserve Board. The board which will be responsible to the SADCC Council of Ministers through the Government of Zimbabwe, as coordinator of SADCC's Food Security Sector. For practical purposes, the board will report to the SADCC

Committee of Agriculture and Natural Resources, of which Zimbabwe is chairman.

A small, full-time food reserve management team will service the FRP. This team, headed by the reserve manager, will be an integral part of SADCC's FSTAU, which is responsible for operating the Regional Food Security Programme. The team will be staffed by professionals drawn from SADCC member states, supported during the training and establishment period by technical assistance where appropriate. The board will direct and monitor the team, but the staff will be administratively responsible to the Food Security Sector Coordinator.

The Food Reserve Board

The board will be composed of one representative from each member state appointed by his government. The work of the board will cover different technical fields with representation supported at the discretion of the government concerned. The board must meet at least twice a year. In keeping with SADCC procedures, the board will conclude its work on the basis of consensus among member states.

The board will determine the priorities and monitor the work programme of the food reserve management team. Representatives will be the management's natural contact point in their own states. Specific duties of the board will include:

- o approving the assessments and forecasts of the amount of foodstocks required by the project;
- o recommending the pricing structure for intraregional foodstocks available to the project for forward purchase and establishing prices according to that structure; and
- o allocating the reserve stock on the basis of the needs of member states in the event that resources are insufficient to meet all requirements.

The board may authorise management to trade foodstocks or other commodities where this is seen to improve regional food security. This provision is intended to help make the project self-sustaining. The board may also reallocate foodstocks entitlement not required by any member state.

The board may authorise imports from outside the SADCC region when foodstocks made available from within the region are insufficient or too expensive to meet project requirements.

The Food Reserve Management

Responsibilities

This unit is the executive arm of the board. Its specific operational duties include:

- o assessing the demand and supply positions of appropriate foodstuffs within the region to determine requirements using mainly, but not only, information collected and reported by the Regional Food Security Programme;
- o administering commodities or funds acquired for the project;
- o preparing necessary technical and situation reports and related recommendations concerning project operation;
- o checking the quality and quantity of the foodstuffs secured by the project; and
- o obtaining verification from member states on the receipt and distribution of the foodstuffs.

Staff

The reserve management staff will include three full-time professionals to manage day to day operation during the course of the three-year project. The project will fund their salaries, allowances, and transfers.

The FSTAU administrative section will be responsible for office management, vehicles and equipment maintenance, processing of publications, travel arrangements, administrative aspects of conferences, communications, financial administration of the reserve management, including operating funds and purchase of equipment, and the preparation of accounts.

The reserve manager will be responsible for managing the unit, including operational transactions regarding the resources allocated for foodstuffs; for communications; and for coordinating the programme with the other food security projects.

The food security analyst will be responsible for making estimates, data analysis, evaluation of food requirements, and proposals for the arbitration of food allocations. He will also be responsible for the data, trade, and statistics held and processed by the reserve management, and for developing area-specific proposals on the productive use of reserve resources to help raise rural incomes in the long term.

The grain trading manager will be responsible to the unit manager for evaluating the potential for supplies; for managing purchases, including futures and options as decided by the board; for drafting contracts and transactions on behalf of the reserve management; and ensuring transport arrangements and quality control.

These professional staff will be drawn from SADCC member states. Depending on their experience and qualifications, short term and extensive training will be provided. Technical assistance will be needed to backstop the training and run-in periods.

Assistance from member states
Under the Project Implementation Memorandum approved by the Council, member states will be responsible for assisting the project to obtain information on the movement of all food aid, and granting priority to transporting and handling food shipped under the project as emergency food aid. Governments are also required to assist the project by enforcing penalties written into the board contracts and incurred by their agencies.

PROCEDURES

Estimating food aid requirements
An estimate of expected production and demand, based on trends is to be made for all member states. These estimates are to be prepared in as much detail (subnational) as possible with the level of detail expanded with experience. This exercise will enable a standard season to be projected for all member states and will form the basis of the evaluation of structural support needs.

These estimates will be prepared and interpreted for local conditions, such as stocks on-farm--mainly by the national and regional early warning systems--using indicators like seed sales, plantings and, of course, the vagaries of the weather. The interpretation will be updated when circumstances demand, but not less than monthly. Emergencies can sometimes be identified early, but the situation can change rapidly any time after the first planting.

The availability calculated will be compared to stocks and trade/aid flows. Standard estimates of demand, including on-farm retentions, will be built-up on the basis of local experience and survey data available from ministries and institutions. These will be developed and improved during the life of the project.

The initial estimates of requirement will be formally revised each February or March, after maize tasselling in the main maize-growing areas. The estimates will be formally revised again in April-May when harvest information is largely complete, or whenever appropriate.

In its function as the focal point for obtaining part of the region's food aid needs within the region, the FRP will be required to prepare estimates of need at two levels--structural and emergency. Structural requirements will be based on the difference between current harvest forecasts and trend production. The emergency hazard will be evaluated where evidence exists. If the demand for food aid exceeds available FRP resources, allocations will have to be made.

Allocation of resources
It is intended that fund resources will be utilised according to need. The board will assess need, based on information provided by member states and the reserve management. Criteria for assessing emergencies and emergency requirements will be those accepted as common practice in the international community.

When resources are insufficient to meet all requests, the board will allocate resources proportionally in accordance with criteria determined by the board. •Member states will retain their national prerogative to approach bilateral or multilateral agencies for additional or alternative assistance.

There is a formula proposed in the feasibility study for pricing forward purchases using resources available to the FRP. This is a preliminary mechanism and has two functions: to enable a simple mechanism to be applied without dispute among member states, as long as this is needed; and to provide some insurance when there is only one potential supplier. The Project Implementation Memorandum gives the board the responsibility for recommending the pricing structure to the Council.

For consignments purchased later in the season for structural support, purchases will be made accordingly to grain availability. Preference will be given to obtaining grain from within the region.

Data collection
Data will be supplied mainly by member states themselves, SADCC's national and Regional Early Warning systems, and SADCC's Regional Information System, being developed under the Regional Food Security Programme. Additional data will be available from international institutions, especially the World Food Programme and the FAO, but also many others. Current and future commodity prices are available from the commercial markets.

Demand in the rural areas.
The longer term development objectives require assessing rural demand. To adequately do this, we must increase our understanding of the effectiveness of food aid distribution. To improve demand assessment and to formulate projects for long term food security, more information is needed on the relative effectiveness of welfare transfers using food aid, compared to using development assistance.

Most member states have yet to develop the necessary information-gathering systems. SADCC's Regional Food Security Programme, the FRP management team, and the parallel training project will support this effort.

FUTURE DEVELOPMENT OF THE PROJECT

With regard to structural deficits, it must be assumed that the steady strengthening of SADCC economies will enable them to increase their production of food grains, or other products in which they have a national comparative advantage, thus eliminating the need for food aid. A transitional period is likely to be necessary, during which contributions to costs by member states are stepped-up. Nevertheless, there will remain a long term need for an emergency fund for the relief of the victims of drought and other natural calamities to which the region is prone.

Because the FRP will hold reserve assets in the form of financial or commodity commitments--rather than physical grain stocks--and because all member states will not benefit equally, a midterm review of the principles of the FRP is scheduled at the end of the second year of operation. This will include a review of proposals for future operation of the FRP beyond the three-year establishment phase. Provisional indications of the self-sustainability and the need and/or desirability of further external funding will be assessed at this time. In addition, directions will be given to guide the formulation of the continuation programme which will be prepared during the third year of the project.

THE PARALLEL TRAINING PROGRAM

A supporting training programme was identified in the 1987 feasibility study. Whereas programme objectives are well defined, a pre-implementation study scheduled for early 1988 will develop implementation details. This excludes the training incorporated in the FRP for its staff.

Current plans are to implement the supporting training programme over a three-year period. Because of the related objectives, this period should coincide with the implementation of the FRP. However, it could be implemented separately.

The programme has three main aims. The first is to enhance the capacity of marketing boards' staple foods storage and marketing operations. The second is to expand the capacity and efficiency of national agencies which utilise cereals for human relief. The third is to promote a broader understanding of food policy issues by national marketing staff and their civil service counterparts.

As far as possible, the programme will be implemented to strengthen the capacity of the existing national institutions in the region to carry out the training. Where needed, training capacity will be expanded. During the identification phase, a budget of US$2.7 million was allocated for training.

Technical training for national marketing boards

This programme would focus on improving the efficiency of the boards to procure, store, and distribute staple foods in order to reduce losses and increase the available food supply. While all the boards have current or planned training programmes, and there is also a limited regional programme, resources are constrained throughout.

Training for national food distribution and food security planning

Institutions involved in food aid distribution are not, as a rule, the established national marketing boards. They are quite often small dispersed units, sometimes poorly organised and with minimal experience. This training component aims to help increase their capacity to manage, receive, handle, and deliver food aid.

Training on food policy development

The objective of this component is to organise short workshops to enable senior national policy makers and marketing managers to study the implications of regional cooperation and integration of national food policies.

To support this objective, preparatory training is proposed to enable middle and senior management staff of national grain marketing boards to expand their technical skills relevant to food policy issues. These would lead to national workshops at which policy makers and marketing board managers would jointly study the effects of policy alternatives.

Administration of the training programme

The training programme envisaged includes a range of technical and administrative activities. Some courses will have to be modified or developed from scratch, and training syllabuses will have to be reviewed. Although national institutions will conduct the bulk of the teaching, the training will require a substantial regional administrative input to develop the technical content. It is therefore proposed that a training manager be appointed from the SADCC community and attached to the FSTAU in Harare, together with a small staff.

This training programme implies that national institutions must undertake considerable work in organisation, course preparation, and teaching. While some institutions in the region may be able to absorb the additional work required without difficulty, some will require specific support. Pending completion of the pre-implementation study, particularly to review these needs, a cost estimate was included to allow for these potential requirements.

Pre-implementation study
A pre-implementation study is proposed to establish the detailed technical and material needs for the training programme. Using the target sectors identified in the FRP feasibility study, the pre-implementation study will prepare a detailed three-year training programme, taking explicit account of staff requirements.

STATUS OF THE PROJECT

Funding to date
The EEC has provided US$0.5 million for the studies already undertaken. The project is now in the pre-implementation phase, supported with technical assistance from the EEC. The Council of Ministers has approved a Project Implementation Memorandum. Work has commenced to consolidate funding for the project management, to conduct a pre-implementation training study (both for 1988), and to assess basic food aid needs. The EEC has indicated interest in funding the project management and training programmes, and also to finance part of the food aid required. Argentina has formally offered 1,490 mt of wheat to the fund and the WFP has agreed to provide transport for its delivery. Considerable additional funding will be needed to implement the programme.

Funding initial operations
Funding of the FRP will depend virtually wholly on external sources during the first three years. The EEC will support the management and training programmes during this period, as well as make available some of the grain requirement. It is hoped that support for foodstuffs can be set up on a multiannual basis to improve planning and to overcome procedural constraints. In the long term, the project is expected to become increasingly more self-reliant in its structural support component, with member states beginning to contribute to operating and foodstuffs costs. The amount and nature of continued international support and contributions from member states will be one of the subjects of the midterm project review.

Commitments will be sought from cooperating parties, based on these initial estimates. Where there is early notification of a high probability of emergency needs, commitments will be sought from cooperating partners--either for special assistance or by converting food aid already designated for structural support.

CONCLUSION

This project is part of the total effort aimed at improving food security in the region, including alleviating the underlying and persistent threat to food security caused by natural catastrophe. It is a cornerstone of the Regional Food Security Programme.

The proposed FRP recognises the opportunities for regional self-sufficiency in the face of all but the most severe drought and aggressive destabilisation. It accepts that from time to time, even the most favourably endowed nations are likely to become net importers of food grains if stocks are maintained at cost-effective levels. It accepts the right of each member state to determine its own food security policy and make its own arrangements with its bilateral partners.

During its first three-year phase, the project will attempt to channel international food aid toward the alleviation of immediate trading constraints by obtaining resources to purchase food from within the region when possible--thereby increasing demand within the region and helping to create more jobs. It is expected that the project will become increasingly self-sustainable. It has long term objectives to increase household incomes and thereby improve long term food security.

Because the problems of food insecurity are great and complex, the project alone cannot attempt to tackle all the problems of all member states. It is part of a wider programme directed towards improving long term food security in the region which is being pursued by member states at both the regional and national level. With its objectives to set up an emergency buffer and support structurally deficient states using regional resources, the project addresses persistent and debilitating food security issues resulting from endemic climatic hazard.

Successful implementation of the project supports the principle elements of SADCC's food security strategy; especially increasing the exchange of information, expanding intraregional trade, mitigating food crises, strengthening national food security strategies and planning, developing skilled manpower, and improving access to food.

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MARKET LIBERALISATION

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EFFECTS OF MARKET LIBERALIZATION ON FOOD SECURITY IN TANZANIA

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INTRODUCTION

During the past decade, Tanzania has faced an unprecedented economic crisis, characterised by severe balance of payments disequilibria, high inflation, and large government budget deficits. Population has grown more rapidly than gross domestic product. Shortages of consumer goods were widespread and intermittent food shortage had to be met by food imports.

To tackle the economic crisis, government implemented several adjustment and stabilization programmes (Ndulu and Lipumba, 1986). These policies culminated in significant devaluation and the liberalization of imports financed by privately-owned foreign exchange. Restrictions on private trade in food grains were relaxed. In June 1986, the government adopted the World Bank and IMF-supported Economic Recovery Programme (ERP). The policy measures taken included a major devaluation and a crawling peg to correct future overvaluation, control of the growth of government expenditures to reduce and limit government borrowing from the banking system, increases in agricultural producer prices, and further relaxation of restrictions on private trade in major food grains. The policy thrust has been to adopt market-oriented policy instruments and to depend less on state-controlled procedures. Since 1984 government has further liberalized the economy.

FOOD SECURITY AND MARKET LIBERALIZATION

Food security and self-sufficiency

Broadly defined, food security means "access by all people at all times to enough food for an active, healthy life" (World Bank, 1986). It entails both the availability of food and the ability of all members of society to have access to adequate amounts of food. At the aggregate level, the country should have adequate food from production, stocks, and imports to meet its citizen's food requirement for an active healthy life. At the household and individual level, all citizens should have entitlement to adequate food (Sen, 1982).

In an economy where food markets function reasonably well and the supply of food is adequate, household and individual food security depend on

[1]Econo[illegible]nics De[illegible]rt[illegible] [illegible]sity [illegible]aam, Tanzania.

income distribution. Individuals with adequate incomes will have access to adequate food; but those with inadequate incomes will face food insecurity, even when the country as a whole has adequate surplus stocks. Thus, policies that help generate incomes to the poor will improve their food security. Where food markets do not function properly, food insecurity may increase--even when individuals have adequate money incomes. In such instances, improving the performance of food markets will generally improve food security.

Food self-sufficiency, supplying staple food requirements from domestic production, is not a necessary condition for food security (Tollens, 1985). With adequate foreign exchange reserves, a country can import food to guarantee food security (Donaldson, 1984). However, for countries with chronic balance of payments disequilibrium, adequate domestic production is a basic element in the food security equation.

At the household level, dependence on subsistence production and limited participation in the market may increase food insecurity. Poor climate will lead to severe transitory food insecurity. Specialisation in nonfood crops does not necessarily decrease food security, as long as food markets perform reasonably well. Indeed, food security will improve if specialization increase real incomes. On the other hand, where food markets do not function well, specialization in nonfood crops will decrease food security. In general, poor performance of food markets will discourage specialization according to regional comparative advantages which, in turn, will decrease national income.

Meaning of market liberalization

Market liberalization, as a concept, refers to reducing state control of markets. It assumes market distortions exist as a consequence of government interventions in both factor and product markets; and that the distortions result in significant opportunity costs in terms of growth. These interventions are justified largely by the rejection of normative judgements of free markets, regarding short-run distributional and welfare concerns of the state. Where the state, rather than the market, makes the allocative decision directly, prices are set to reflect perceived social values and needs (Timmer, 1986). If prices significantly deviate from their scarcity value, a major conflict arises between short-run policy concerns about welfare needs and the long-run growth prospects which require efficient use of scarce resources.

Market liberalization and food security

Market liberalization is concerned with reducing the gap between set prices, which reflect policy intervention goals, and prices which reflect scarcity values. In the practical policy world, liberalization seeks out "efficient" intervention and not necessarily "nonintervention". Efficient intervention minimise sustained growth opportunity costs to achieve short-run welfare targets which are largely distributional. Ineffective interventions, and those with unintended effects, are prime candidates for removal.

In the food market, government intervention has taken two major lines. On the one hand, governments have sought to maintain low and stable consumer prices to ensure access to cheap food. On the other hand, they have tried to maintain high and stable producer prices to induce increased food availability. These policies have required government to use budgetary subsidies to cover the gap and restrict trade to state monopolies for effective implementation. These interventions have stifled investment and adoption of innovation by limiting income growth.

In the context of food security, market liberalization is relevant not only to interventions in the food market, but also to macroeconomic policies which influence income and the dynamism of the agricultural sector. In urban areas, incomes and prices are important components of food security. Families eat what they can afford. In rural areas, consumption depends largely on what households can produce for themselves and can afford to buy to supplement their own food production. In this case too, incomes and prices are important.

Food availability is largely determined by the supply of food (either domestically produced or imported) which is influenced by the incentive structure, investment policy, import capacity, and a flexible institutional structure. The incentive structure encompasses producer pricing, availability of incentive goods, and the overall agricultural terms of trade--particularly relative prices.

While an appropriate incentive structure is important to induce both short-run supply responses and long term agricultural sector growth, incentives are only effective when combined with supportive infrastructural investments. Transport infrastructure, extension services, marketing infrastructure, agricultural research, and production infrastructure such as irrigation are probably the most important infrastructural interventions for increasing food supplies, raising agricultural productivity, and the realization of producer's efforts.

Due to Tanzania's high reliance on rainfed agriculture, food supplies are highly erratic. To ensure adequate supplies, the country has had to frequently rely on imports during bad harvest years to supplement local supplies and stocks. Thus, the ability to bridge food supply shortfalls has depended on the country's import capacity. Consequently, the performance of the export sector and proper management of foreign exchange reserves is critical, given the many competing demands on the country's limited foreign exchange earnings.

Paradoxically, the agricultural sector is one of the most "public" in terms of policy and programme needs, but at the same time one of the most "private" in terms of day to day production, marketing, and consumption decision making (Timmer, *opt. cit.*). Managing such a complex sector requires that government recognizes this dichotomy, while realizing the complementarity between the public and private sectors. Intervention should not interfere excessively with the micro level decision-making process, but rather canvas it for national policy goals.

Factors affecting access to food

Access to food is influenced by consumer-pricing policy, incomes policy, and food trade restrictions. Effective consumer pricing (subsidy) policy depends partly on the relative availability of commodities on the supply side and partly on budgetary ability to finance it, given growth in food demand. Generalized subsidies on commodities consumed by both rich and poor households are an attractive policy option because they are simple to administer. Also, it is difficult to identify households below the poverty line that would qualify for income-determined subsidies. The key disadvantage of generalized subsidies, from the point of view of poverty alleviation, is that leakages to the rich are often large. In cases where generalised subsidies are introduced without adequate supplies--and a parallel market develops--the poorer, less influential households may not have the intended access to cheaper food. Removing subsidies under such conditions has little impact on the welfare of the poor. If subsidized prices are maintained by keeping producer prices low, food scarcity is exacerbated and rural incomes decline--worsening the poverty problem. In this case, appropriate liberalization would entail drawing up an effective subsidy programme which responds to target welfare needs without encroaching on producer incentives.

On incomes policy side, both real income (ability to acquire food) and income distribution (for identification of vulnerable groups) are important. For urban households, wage policy plays a major role in determining real wage incomes in the formal labour market. However, the prevalence of informal sector activities and large incomes form these activities makes analysis of the impact of wage policies on real income difficult, due to the paucity of reliable data. The fluidity of the adjustment processes in this sector and the frequent participation of typical households in both sectors further complicates the analysis. Typically, wage polices under adjustment and stabilization programmes limit (or sometimes freezes) salary and wage increases. Real wages tend to fall as prices increase faster. The reactions, even in the absence of strong labour unions, are not passive. Often households respond by making micro adjustments such as increasing their informal sector activities and reducing work time to match real wage declines.

For rural households, producer prices and physical productivity are important income determinants. The distribution and ownership of productive resources--especially land tenure--play a key role in the distribution of rural incomes. Market liberalization typically involves raising the relative profitability of tradeables by reducing currency overvaluation. Since export crops are predominantly produced by self-employed smallholders, devaluation will increase the incomes of these producers and also benefit consumers of non-traded goods.

HISTORY OF AGRICULTURAL DEVELOPENT POLICY AND ITS IMPACT ON FOOD SECURITY

At independence, Tanzania inherited a dualistic agricultural sector. The plantation and estate sector, mainly owned by settler farmers, accounted for 35 and 40% of exports and marketed output (by value), respectively. Sisal was the leading export and plantation crop. Estates produced up to 50% of the coffee and almost all tea, tobacco, sugar, and wheat. Peasants dominated cotton, cashew nut, and oil seed production. The peasant sector was self-sufficient in food production and some "progressive farmers" produced adequate grain surpluses, particularly maize, to feed the urban areas.

Early interventions in the food market

Historically, Asian traders have dominated agricultural marketing outside the few areas with strong cooperatives. They were considered exploiting middlemen, not only by nationalist politicians, but also by some colonial officials. State intervention in agricultural marketing in general, and grain marketing in particular, preceded independence. From 1946 to 1957, the Grain Storage Department had a monopoly to purchase all commercial production. It set high maize producer prices to encourage production, which led to surpluses that were exported at a financial loss to the colonial government. Guaranteed producer prices and government control of grain marketing was abandoned in 1957 and free grain markets, where prices were determined by supply and demand, prevailed until independence in 1961.

Changes following independence

Independence marked the beginning of a new era of government control of agricultural marketing. Following the 1960-61 drought, maize prices (particularly in Dar es Salaam) increased sharply and grain traders were blamed for the high price increases. In response, the government introduced the *Agricultural Products Act of 1962* aimed at "controlling and regulating the product, cultivation, and marketing of agricultural products" (Kriesel, *et al.*,1970, p.19). The act established a three-tier single-channel marketing system which granted the National Agricultural Products Board (NAPB) a monopoly to purchase commercial grain. Only direct sales from producers to consumers were allowed and approval from the NAPB was required to transport significant quantities of grains. The NAPB appointed Cooperative Unions as marketing agents which, directly or through their cooperative societies, purchased maize and other food products from farmers and sold the produce to the NAPB for resale to grain millers. The main objective of the NAPB was to eliminate the middlemen. Kriesel *et al.* (1970, p.21) quote an NAPB report, stating that:

> The one channel marketing system is designed to ensure that the price, movement, storage, and final export (or internal sale) of produce is centrally organised and controlled by a government agency. It does not necessarily operate cheaper than the "free" trade system but tends to eliminate the profit making middleman.

As we will see, intervention in the marketing of agricultural products has been a persistent characteristic of the political economy of agriculture in Tanzania.

First development strategy

After independence, the government's agriculture development strategy was influenced by the World Bank report, *The Economic Development of Tanganyika* (1960). The proposed transformation approach was seen as the only possible way to achieve rapid agricultural growth. It involved settling Africans in newly-opened lands to start relatively capital intensive modern farms under the supervision of extension officers--thereby breaking away from traditional agriculture.

These settlement schemes were the cornerstone of the agricultural development strategy of the *First Five-Year Development Plan (1964 to 1969).* These settlements were expensive. It was estimated that each settlement, which was supposed to include 250 comprehensively-planned individual farms with adequate social and economic infrastructure, would cost Tsh3.0 million. Sixty pilot projects were to be established by 1970 and 200 by 1980, upon completion of the 15-year perspective plan. Of the Tsh560 million planned to be invested in agriculture, the government allocated Tsh380 million to establish these new settlements.

Another development strategy involved encouraging farmers to improve their agricultural practices through extension and education. This "improvement approach" was a continuation, in mild form, of the colonial agricultural extension strategy that attempted to regulate farming practices and control soil erosion through agricultural by-laws.

In agricultural marketing, as noted above, the government gave the Cooperative Unions a monopoly to purchase commodities from farmers. In addition, the government introduced marketing cooperatives throughout the country, even in areas where they did not previously exist. The extensive introduction of marketing cooperatives increased marketing costs because most cooperatives incurred large overheads, and a lack of strict accounting and financial control systems led to grandiose theft (URT, 1968).

The officially-adopted development strategy failed to increase output. The settlement schemes were a costly failure. The capital equipment was not utilised to increase production. Also, peasants considered the settlement schemes to be government farms. Thus, in 1966 the transformation strategy was abandoned because the settlement schemes produced very little output, despite huge capital investments.

Post-independence production

Despite the failure of the official development strategy, in the first seven years after independence agricultural output grew rapidly, especially peasant production of export crops (Table 1).

Table 1. Production of main export crops, 1960-68, Tanzania (000 mt).

Crop	1960-62 Average	1966-68 Average	Growth rate Per annum (%)
Sisal	202.3	197.5	-0.5
Coffee	23.6	48.1	12.5
Cotton	33.5	70.0	13.0
Cashewnuts	45.1	74.3	9.0
Tea	4.0	6.4	8.0
Tobacco	2.2	3.8	10.0

Source: Coulson (1982).

Particularly significant, the growth in export crop production did not occur at the expense of food crop output, but as a result of an increase in cultivated area. Widespread availability of consumer goods and surplus land allowed peasants to expand their area in cash-earning crops, enabling them to purchase off-farm consumer goods. Thus, despite stagnating or even declining producer prices, peasant production of export crops increased.

On the whole, food supplies were adequate and the growth rate in food output was higher than the population growth rate. Net maize imports were only large in 1961 and 1962, largely because of drought. By 1968 Tanzania had a surplus of 50,000 mt of maize which it exported at a loss (Coulson, 1982). In the 1967-68 budget speech, the Minister of Finance noted that FAO and the Economic Commission for Africa statistics showed that Tanzania was the only African state which "has consistently maintained a growth trend in food production higher than that of population during the entire period 1954 to 1966. This record is a high tribute indeed to the energy and initiative of the Tanzania farmer" (URT, 1967).

The increase in agricultural production was not caused by an increase in productivity. Farmers only used limited amounts of modern nonfarm inputs such as fertilizer and pesticides, mainly on crops which peasants grew for the first time. Tilling technology did not change as only a few areas benefited from the high-cost tractor hire system that was run by the cooperatives and subsidised by the government.

The *Arusha Declaration* and villagization

President Nyerere viewed the development of cash crop farming as leading to capitalist development in the rural areas. He argued that:

> Over large areas of the country peasant spend at least part of their time... on the cultivation of crops for sale--crops like cotton, coffee, sisal, pyrethrum, and so on. But in this process, the old traditions of living together, working together and sharing the proceeds has often been abandoned. Farmers had to work as individuals, in competition and not in cooperation with neighbours. And in many places, our most intelligent and hard-working peasants have quite important farms of 10, 20, or even more acres. To do this, they have employed other people to work for them (Nyerere, 1967).

The objective of the *Arusha Declaration* (1967) was to arrest capitalist development in the rural areas by establishing Ujamaa villages-- "economic and social communities where people live together and work together for the good of all". However, private household farms continued to produce the bulk of food and export crops. Communal farms have never accounted for more than 0.5% of total cultivated land, although government policy, particularly Presidential directives, have favoured communal production. The Presidential Circular No. 1 directed that:

> All government policies, activities, decisions of all government officials must therefore be geared toward emphasizing the advantages of living and working together for the good of all; they should be angled at discouraging the continuation of private farming and should dampen down the urge for private expenditure on consumer and farm durables in favour of communal expenditure on things like cooperatively owned farm implements, stores, water supplies, good houses, dispensaries, nursery schools, roads, community centres, and so on... This means that it is to be the building of Ujamaa villages that government must now turn its attention. We have to organize our government and party machinery to assist their establishment. We have to give them priority in all our credit, servicing, and extension services at the expense of the individual producer if necessary, and we also have to shift the emphasis of the cooperative movement from marketing to producer cooperatives. Cooperative farming and cooperative production must be looked upon as the main source of economic growth in rural areas ... (Nyerere, 1969).

With the president firmly advocating such policies, institutional and political support for private farms, even those owned by smallholders, was limited. Thus, despite the Arusha Declaration's emphasis on rural development, policies that provided incentives to individual farmers to increase output were neglected, as we shall see later.

Voluntary movement into Ujamaa villages was slow and below the political leaders' expectation and desire. As a first move towards establishing Ujamaa villages, the government initiated operations to settle people in permanent villages. Initially, this was confined to the poorest areas such as Dodoma, Kigoma, and Rufiji. In 1973, the TANU Biennial Conference resolved that all the rural population should be living in permanent villages by 1976. During the next three years, 1974 to 1976, many rural families were moved into 8,000 villages.

Agricultural considerations did not guide village location. In most cases, the new villages were located close to a road. In the southern highlands, villages were located on ridges because roads were on ridges, although most of agricultural land was in the valleys (Friis-Hansen, 1987). Many villages grew too large, resulting in a scarcity of farm land close to villages.

The villagization program disrupted production and increased real costs by increasing the distance from peasants' homes to where their farms were located. Lofchie (1978) attributed the 1974 fall in agricultural production to the villagization campaign. He asserts that "there is a compelling reason to believe that the program of collective villagization was the major cause of a crisis in agricultural production of calamitous proportions" and dismisses climatic factors. Apart from mixing villagization with collectivization, he missed the fact that a drought occurred in 1973-74, before villagization. Agricultural production decreased even in areas like Kilimanjaro which were not affected by villagization. While villagization had a long term adverse impact on agriculture, intellectual honesty requires not dismissing external factors simply because the government followed a wrong policy after the drought.

Market interventions in the 1970s

Before 1976, cooperatives had a monopoly on agricultural marketing. Many were inefficient, incurred financial losses, and delayed paying or never fully paid the peasants (Saul, 1971). The government abolished all cooperatives in 1976 and introduced government-owned Crop Authorities responsible for purchasing, processing, exporting, or selling locally; and providing extension services. Government's policy of abolishing cooperatives was nonselective. A few Cooperative Unions were relatively efficient, had grass root support, and a long tradition of delivering services to farmers. Since relatively larger farmers controlled these cooperatives and were influential in local politics, the political objective of abolishing cooperatives was to remove an independent political base of the "Kulak" farmers.

The Crop Authorities did not eliminate inefficiencies in agricultural marketing, one of the leading stumbling block to rapid agricultural development. The losses incurred by the Crop Authorities, partly due to the shilling's overvaluation and partly to their inefficiency, had to be covered by the government budget which started recording a recurrent budget deficit for the first time in 1978-79. In 1984 the government reintroduced Cooperative Unions. Again, the policy was nonselective. With few exceptions, similar cooperative structures were introduced in each region, regardless of whether there existed a tradition or grass root support of these institutions. Moreover, the Regional Cooperative Unions were supposed to purchase all surplus agricultural crops. In our view, many are over extended and have already incurred financial losses.

In 1967 after the Arusha Declaration, the state increased its control of the grain market by nationalizing the major grain milling companies and forming the National Milling Corporation (NMC). Until 1972, the National Agricultural Product Board (NAPB) controlled staple food grains (maize, rice, and wheat) marketing. The government set the NAPB into store price and the cooperative unions set producer prices after deducting marketing costs. In 1973 the NMC took over the activities of NAPB, and the NMC continued to use the Cooperative Unions as purchasing agents. When the Cooperative Unions were abolished in 1976, NMC took over direct purchasing of grain from producers; and transporting, milling, and wholesaling to the state-owned National Distributors Limited (NDL) and Regional Trading Companies (RTCs).

State intervention in commerce is not confined in agricultural marketing. After the Arusha Declaration, import, export, and wholesale trade were nationalized. Overtime, competition in wholesale and retail trade eroded, reducing the quality of services offered to peasants as consumers and producers. The trade confinement policy gave monopoly power to a few agencies, particularly RTCs, to sell essential inputs and consumer goods. This increased shortages, particularly in regions where the RTCs had liquidity problems.

Impact of administrative controls

Gradually, administrative controls on the economy increased and peasant incentives to produce for the official market deteriorated. During the 1970s real prices of official agricultural products declined, particularly for exports (Table 2). Real producer prices of exports declined, mainly due to the high marketing margins of official marketing agencies and an increasingly overvalued currency. The government responded to the severe food shortage in 1974 by increasing official food crop prices, including less preferred foods such as cassava, sorghum, millet, and cowpeas. Officially marketed output of these crops increased significantly; but because the NMC was unable to sell these crops locally, they were exported at a loss. Official prices of preferred staples (mainly maize and rice) remained below the free market prices, except in remote regions such as Rukwa and Ruvuma (URT, MDB; various years a). Thus, officially marketed output generally decreased, except when there was a bumper harvest such as in 1977-78 and 1978-79.

<u>Investment in agriculture</u>

The adverse terms of trade facing the agriculture sector pulled resources away from agriculture. Also, institutional uncertainty discouraged investment in the agricultural sector. As relative prices of food crops tended to improve, smallholders allocated more of their resources into food production, relative to export crop production. Thus, food production grew while export production fell (Tables 3 and 4). The Ministry of Agriculture estimated that food production output grew at a high rate of approximately 8% for maize, paddy, and sorghum and millet during 1963-64 to 1983-84 (Table 4).

Table 2. Index of real producer prices for various categoriesof agricultural products, 1972-87, Tanzania (1985=100).

Commoditytype	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Predominant staples	91	88	86	98	126	122	117	101	91	79	90	78	81	97	100	92
Drought staples	NA	101	134	123	132	147	151	136	106	84	70	75	80	91	100	92
Oilseeds	94	102	94	101	113	122	138	126	102	89	81	80	85	91	100	93
All home consumed items	92	91	94	100	125	130	137	120	102	86	88	78	83	96	100	93
Annual export products	145	146	119	116	131	123	123	110	105	91	85	85	83	84	84	100
All export products	153	141	126	118	122	133	160	135	114	101	92	88	96	97	100	119
All	142	132	120	114	123	133	156	132	112	98	91	87	94	97	100	114

Source: URT, MDB (1986).
The years designate the marketing year. For example, 1972 refers to 1971-72. NA indicates data not available.

Table 3. Volume of major exports, selected years during the period 1966-85, Tanzania (000 mt).

Commodity	1966	1970	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Coffee	43.4	44.8	41.1	54.4	57.9	46.5	50.8	43.5	43.5	67.9	54.8	50.7	52.2	51.0
Cotton	86.2	60.7	50.0	40.0	58.0	40.0	47.0	39.0	31.0	44.5	38.9	40.0	27.4	32.0
Sisal	198.9	217.2	94.0	97.0	91.0	68.0	79.0	78.0	48.0	57.7	50.7	26.8	27.1	11.0
Tea	6.3	6.9	10.0	10.0	12.0	12.0	15.0	15.0	13.0	15.4	11.9	16.9	10.6	11.0
Tobacco	2.4	6.0	12.0	9.0	16.0	12.0	11.0	7.0	8.0	10.9	10.1	5.3	4.6	11.0
Cashew nuts	72.2	77.4	11.0	97.0	66.0	75.0	44.0	38.0	9.0	25.1	17.2	10.5	14.8	11.0
Cloves	14.4	4.8	3.7	7.5	7.2	5.9	1.2	5.3	7.6	6.8	5.7	0.9	2.0	13.0

Source: URT, CED (various years) and URT (1986a).

Table 4. Ministry of agriculture estimates of production of major grains, 1964-84, Tanzania (000 mt).

Year	Maize	Paddy	Wheat	Sorghum
1963-64	612	147	27	238
1964-65	532	73	33	266
1965-66	751	133	38	295
1966-67	629	110	35	265
1967-68	647	126	45	286
1968-69	602	138	41	282
1969-70	746	184	71	326
1970-71	730	193	84	279
1971-72	900	171	98	294
1972-73	853	214	87	277
1973-74	1,027	192	78	327
1974-75	1,272	241	49	435
1975-76	1,661	194	78	525
1976-77	1,654	354	59	604
1977-78	1,611	375	85	825
1978-79	1,888	351	71	1,157
1979-80	1,855	305	87	850
1980-81	1,840	350	91	705
1981-82	1,954	415	95	979
1982-83	2,324	409	71	793
1983-84	2,547	511	72	1,158

Source: Odegaard (1985).

While these growth rates exceed the population growth rate of 3.3% and may appear exaggerated, the household budget surveys of 1969 and 1976-77 indicate a similar growth rate for maize and a lower growth rate for paddy. Even with these high growth rates, per capita daily caloric intake was 2012 cal in 1976-77, compared to 1365 cal in 1969. Available data suggest that the production and consumption of maize increased at the expense of root and tuber crops.

Food imports

Food imports have been important since the early 1970s, although they have fluctuated widely and do not show an increasing trend (Table 5). In 1973-74 total imports of maize, wheat, and rice reached a peak of 396,000 mt, mainly because of a major drought. Large quantities of maize, wheat, and rice were also imported in 1980-81 (389,000 mt) and 1981-82 (369,000 mt). Since 1973-74 per capita food imports have tended to decrease although the level has fluctuated widely.

From 1980-81 to 1983-84, when Tanzania was facing a severe balance of payments crisis that continues to the present, imports of major grains were persistently large. During this period, dependence on food aid was at its highest, accounting for 70% of total imports of maize, rice, and wheat (by value). Without the availability of food aid for famine relief, food insecurity--particularly in the urban and frequent food shortage regions like Dodomo--would have increased.

Fiscal burden

Prior to the 1974-75 food crisis, producer prices were determined by reducing the marketing margins from the into store price. After 1974-1975, the government increased producer prices to encourage production and set lower consumer prices to protect consumers. Yet, the increases in producer prices were inadequate to encourage peasants to increase their sales of maize and rice through official channels. Also, these policies resulted in large losses to the NMC which were covered by a subsidy from the government budget. Over time, the subsidy to NMC became an increasingly large fiscal burden, particularly after 1978 when the recurrent budget was persistently in deficit. The fiscal burden grew larger, the higher the proportion of domestically produced food grains in the NMC's total sales, because imports were cheaper due to the overvalued shilling.

Exports

The overall impact of government intervention in agriculture contributed to the falling volume of exports that worsened the foreign exchange shortage that was triggered by the first increase in oil prices in 1973. Following the

Table 5. Imports and exports of major grains, 1967 to 1986, Tanzania (000 mt).

Year	MAIZE Imports Commercial	MAIZE Imports Aid	MAIZE Imports Total	MAIZE Exports	RICE Imports Commercial	RICE Imports Aid	RICE Imports Total	RICE Exports	WHEAT Imports Commercial	WHEAT Imports Aid	WHEAT Imports Total	WHEAT Exports
1966-67	NA	NA	14.3	7.0	NA	NA	7.6	2.0	0.0	0.0	0.0	0.0
1967-68	0.0	0.0	0.0	0.5	NA	NA	5.7	0.4	NA	NA	13.6	1.0
1968-69	NA	NA	0.0	32.0	0.0	0.0	0.0	0.1	NA	NA	36.7	0.0
1969-70	NA	NA	49.9	28.0	0.0	0.0	0.0	0.5	NA	NA	35.7	0.0
1970-71	0.0	0.0	0.0	24.0	0.0	0.0	0.0	4.0	NA	NA	11.6	0.0
1971-72	NA	NA	92.3	29.0	0.0	0.0	0.0	7.0	NA	NA	45.4	0.1
1972-73	NA	NA	78.9	0.0	NA	NA	72.9	7.0	NA	NA	8.2	0.3
1973-74	NA	NA	291.1	0.0	NA	NA	14.3	0.0	NA	NA	91.0	0.3
1974-75	NA	NA	225.4	0.0	NA	NA	21.0	0.0	NA	NA	28.8	0.0
1975-76	79.5	27.0	106.5	0.0	20.8	0.0	28.8	0.0	14.4	45.7	60.2	0.0
1976-77	34.6	7.0	41.6	0.0	5.3	0.0	5.3	0.0	0.0	33.6	33.6	0.0
1977-78	0.0	34.2	34.3	0.0	26.5	21.6	48.1	0.0	0.0	40.5	40.5	0.0
1978-79	0.0	0.0	0.0	49.0	21.0	20.2	41.2	0.0	15.8	45.5	61.3	0.0
1979-80	32.5	0.0	32.5	28.0	4.6	50.7	54.7	0.0	0.0	32.5	32.5	0.0
1980-81	188.1	86.5	274.6	0.0	14.2	51.0	65.2	0.0	0.0	48.7	48.7	0.0
1981-82	14.5	217.1	231.6	0.0	0.0	66.5	66.5	0.0	0.0	70.9	70.9	0.0
1982-83	17.0	106.4	123.4	0.0	0.0	29.4	29.4	0.0	9.4	2.0	11.4	0.0
1983-84	125.1	69.2	194.3	0.0	30.4	26.7	57.1	0.0	0.0	46.3	46.3	0.0
1984-85	110.9	17.6	128.5	0.0	13.7	22.4	36.1	0.0	11.5	21.8	33.4	0.0
1985-86	3.1	3.0	6.1	0.0	8.5	24.4	32.9	0.0	5.5	16.3	21.8	0.0

Source: URT, MDB (various years b)
NA indicates data not available.

Uganda war in 1978-79 and the second oil price shock in 1979, the balance of payments situation worsened--increasing the shortage of intermediate inputs used to produce consumers goods and agricultural inputs. The shortage of consumer goods was particularly severe in rural areas. To protect consumers, the government imposed price controls on most goods. As a result, parallel markets developed; but the shortage of goods remained acute in the rural areas, even in the parallel market.

Market production

The lack of incentive goods generally discouraged production for the market, particularly the official market. To increase the flow of food to official channel, the authorities restricted the movement of food grains across district boundaries. Roadblocks were set up to inspect vehicles and prevent unauthorised transport of food grains. This increased the risk premium and cost to individuals illegally transporting grains as they had to bribe their way through the roadblocks. In addition, the foreign exchange shortage increased transport costs due to intermittent shortages of fuel, a lack of spare parts, and a deteriorating and decreasing stock of vehicles. The risk premium and the high costs were passed to consumers because the parallel market was a sellers' market. Rent incomes from parallel market activities were high and attracted young people into petty trading.

Government's response

The government grappled with the economic crisis with little success. In 1980, it introduced the National Economic Survival Plan (NESP) that attempted to resolve the crisis by setting unrealistic targets on exports without adequate policy instruments to achieve those targets. The World Bank sponsored Tanzania Advisory Group (TAG) developed a Structural Adjustment Programme (SAP), based on financial inflow from the World Bank and the IMF of US$600 million over three years (1982-83 to 1984-85). As the government did not reach an agreement with the IMF and the World Bank on devaluation and other policy measures, the SAP was never fully implemented.

The government was unwilling to tolerate the intensification of parallel market activities, so in 1983 it attempted to crush the parallel market by declaring a "war against economic saboteurs and racketeers." Many parallel market traders were detained and tried in special courts. Since the shortage of goods was real, it did not end with the imprisoning of some racketeers.

The government-appointed Task Force on the Agricultural Sector examined past policies and recommended adopting market-oriented agricultural development policies with a strong incentive structure. In 1983 after some hesitation, the government adopted the policy recommendation, but those policies have yet to be completely implemented.

In 1984 the government adopted policy measures that departed from its previous policy stance. These policies included reducing government ministries to streamline administration and reduce government expenditure; reintroducing cooperatives and removing Crop Authorities; devaluing the shilling by 26% (in dollar terms); substantial increasing producer prices for major export and food crops; removing consumer subsidies; and most important, allowing individuals who owned foreign exchange to import goods and sell them at whatever price they could fetch. In effect, the government adopted a more liberal attitude to the private sector.

IMPACT OF POLICY INTERVENTIONS ON FOOD SECURITY

Government interventions in the food market have had two main and seemingly conflicting objectives. On the one hand, government has sought to achieve food self-sufficiency through increased production. On the other hand, it has attempted to enhance access to cheap food by poor urban consumers through food subsidies. Achieving the two objectives requires simultaneously maintaining high real prices to producers to stimulate increased production and keeping consumer prices low.

The previously described control regime has had an impact on both availability and accessibility to food. On the availability side we will review the trend of real producer and open market prices for major staples, official marketed quantities, food availability index, the coefficient of variation of food prices, the share of marketed output going to official markets, open market consumer prices, and the purchasing power of the urban minimum wage earners.

Producer prices

A closer look at real official producer prices of maize, paddy, and wheat shows they have generally declined after the 1975-76 peak (Table 6) due to the accelerating rate of inflation which Tanzania has experienced in recent years. Thus, even substantial nominal price increases were insufficient to increase the real value of the producer prices.

The average inflation rate increased form 13% during the period 1973-74 and 1977-78 to about 30% by 1981-82. During the same period, the real producer price of paddy has fluctuated less than that of maize. For wheat, the situation was even worse. Not only has the real price been declining

Table 6. Real producer prices of maize, paddy, and wheat 1971-72, to 1986-87, Tanzania (Tsh per kg)[a].

	Maize		Paddy		Wheat	
	Money Prices	Real Prices	Money Prices	Real Prices	Money Prices	Real Prices
1971-72	0.24	2.72	0.52	5.88	0.59	6.45
1972-73	0.26	2.70	0.56	5.81	0.57	5.92
1973-74	0.33	3.00	0.57	5.14	0.57	5.14
1974-75	0.55	3.66	0.65	4.76	0.77	5.64
1975-76	0.80	5.07	1.00	6.34	1.00	6.34
1976-77	0.80	4.64	1.00	5.80	1.20	6.96
1977-78	0.85	4.41	1.20	6.22	1.25	6.48
1978-79	0.85	3.94	1.20	5.56	1.25	5.80
1979-80	1.00	3.88	1.50	5.82	1.35	5.24
1980-81	1.00	2.95	1.75	5.16	1.65	4.87
1981-82	1.50	3.57	2.30	5.48	2.20	5.24
1982-83	1.75	3.15	3.00	5.39	2.50	4.49
1983-84	2.20	3.11	4.00	5.66	3.00	4.25
1984-85	4.00	4.00	6.00	6.00	4.50	4.50
1985-86	5.25	3.89	8.00	5.93	6.00	4.44
1986-87	6.30	3.18	9.60	5.69	7.20	4.34

[a]Tanzania CPI used as deflator
Source: UTZ, MDB (1986a).

Table 7. Official[a] purchases of maize, paddy, rice, and wheat, 1971-72, to 1986-87, Tanzania (000 mt)

Marketing Year	Maize	Paddy	Rice	Total	Wheat	Total preferred staples
1971-72	43.0	68.6	NA	44.6	56.7	144.3
1972-73	106.4	73.1	NA	47.5	46.8	200.7
1973-74	73.8	59.6	NA	38.7	27.9	140.4
1974-75	23.9	22.7	NA	14.8	14.4	53.1
1975-76	91.1	11.7	4.4	12.0	24.5	127.6
1976-77	127.5	12.2	6.7	14.6	27.1	169.2
1977-78	213.2	24.6	19.1	35.1	35.3	283.6
1978-79	220.4	26.9	16.5	34.0	28.8	283.2
1979-80	161.5	29.7	10.9	30.2	26.6	218.3
1980-81	104.6	4.8	10.4	13.5	27.9	146.0
1981-82	89.4	4.5	12.1	15.0	23.1	127.5
1982-83	86.0	12.1	13.0	20.9	31.2	138.1
1983-84	71.0	13.5	13.3	22.0	28.3	121.3
1984-85	90.0	5.5	8.6	12.2	33.2	135.4
1985-86[b]	178.5	24.5	NA	15.9	50.3	244.7
1986-87[b]	127.8	17.5	NA	11.4	33.7	172.9

[a]Official channels include NMC, its predecessor, the National Agricultural Products Board (NAPF), and Regional Cooperative Unions (RCU's).
[b]Purchases by (RCU's)
Source: URT. MDB (various years a)

the late 1970s, but in 1986-87 the nominal producer price (Tsh7.20 per kg) fell to its second lowest real price since 1971-72. The main reasons for low official nominal prices to farmers were the governments' input subsidization policy and budgetary pressures stemming from the government's coverage of NMC losses.

Input use

Government believed that it could modernize agriculture by subsidizing producer efforts. This strategy failed to have the intended impact, except in a few regions such as Ruvuma, Iringa, Mbeya, and most recently Rukwa. Even in these regions there is no conclusive evidence to show that input subsidization led to improved farming.

Several problems contributed to policy's ineffectiveness. First, there was apparent competition for inputs between food and export crops, with the latter taking a greater share. Second, due to governmental budgetary constraints, demand greatly exceeded available supply. As a result, many farmers did not apply recommended quantities. Also, inputs were distributed late due to transportation bottlenecks.

Production and official marketings

These policies worked against achieving food self-sufficiency as incentives to increase production declined. Low real producer prices and late payments to farmers were the main factors responsible for the decline in official staple grain purchases, especially maize between 1978-79 to 1984-85 (Table 7). The period of declining official maize purchases corresponds closely to the period of declining real producer prices. Due to the growing food shortages and low real producer prices paid by the official marketing agencies, a parallel market began to develop. Although data on open market producer prices are only available for the last four years, it is generally accepted that these prices have been higher over most of the period (URT, MDB; 1986a).

In years when the price differential between official and open market prices was narrower than during previous years, official purchases of food grains increased. For example, official maize purchases increased significantly between 1984-85 and 1985-86 (Table 7), not only due to a bumper harvest but also because the more relaxed official attitude towards the open market which resulted in relatively low open market prices--particularly for rice and wheat Apart from rice and wheat, open market producer prices for maize and paddy fell during that period (Table 8).

The absence of an effective system for enforcing official subsidized prices meant that consumers had to rely on the parallel market for their basic foods. Existing time-series data on open market consumer price for maize, rice, and wheat from the early 1970s to the early 1980s show that they were almost always significantly higher than official consumer prices (Table 9). Beginning in November 1982, the MDB started collecting such data monthly. Higher open market consumer prices are not totally a result of excess demand, but are also due to high transport charges and costs associated with the risks of being caught trading illegally.

Table 8. Open market producer prices for maize, paddy, wheat, and rice, 1982-83 to 1985-86, Tanzania (Tsh per kg).

Year	Maize	Paddy	Rice	Wheat
1982-83	3.80	4.06	10.80	5.15
1983-84	10.93	9.12	11.30	NA
1984-85	7.57	10.82	18.09	12.03
1985-86	7.52	9.42	29.26	22.18

NA indicates data not available.
Source: URT, MDB (various years a).

Table 9. Official and open market consumer prices for maize flour, maize grain, rice, and wheat, 1973-74 to 1985-86, Tanzania (Tsh per kg).

	MAIZE			RICE		WHEAT	
	Flour		Grain			Flour	
Year	Official	Open OMPM		Official OPR	Open OMPR	Official OPWF	Open OPMFW
1973	0.80	NA	NA	1.65	NA	1.65	NA
1974	1.25	NA	NA	2.00	NA	2.40	NA
1975	1.25	NA	NA	4.00	NA	3.75	NA
1976	1.75	NA	NA	4.00	NA	3.75	NA
1977	1.75	NA	NA	3.50	NA	3.75	NA
1978	1.75	NA	NA	3.50	NA	3.75	NA
1979	1.75	NA	NA	3.50	NA	3.75	NA
1980	1.25	NA	NA	5.35	NA	5.65	NA
1981	2.50	NA	NA	5.35	NA	5.65	NA
1982	2.50	5.90	NA	5.35	15.85	5.65	17.80
1983	2.50	10.58	12.20	7.20	24.05	8.00	25.12
1984	8.00	13.29	10.78	13.40	29.03	14.50	41.31
1985	13.75	17.14	9.65	14.50	13.57	17.20	35.53

Source: URT, MDB (1986a).

Availibility of consumer goods

Shortages of nonfood consumer goods affected rural areas the most. A survey of rural households in four regions of Tanzania found that 40 to 50% of the households were sometimes unable to purchase agricultural implements; and over 90% could sometimes not buy consumer goods such as sugar, soap, and cooking oil. The high coefficient of variation of quantity bought (ranging from 0.4 to 1.0 for official purchases and 0.2 to 1.3 for unofficial purchases) confirms the probabilistic nature of household access to consumer goods in both official and open markets (Collier, *et al.*, 1985).

Food availability in urban areas has also deteriorated from the late 1970s. Using data on availability of 25 foodstuffs in 20 unregulated urban food markets, Collier constructed an index of availability for the 1978 to 1982 period. These data indicate that the proportion of attempted, but unsuccessful purchases rose sharply between 1978 and 1982 (Table 10.)

Traders in the parallel markets have faced difficulties, due to their status as illegal participants and high transportation costs. From the 1960s to 1980, the trade network was insufficiently dense to form an integrated parallel market. A MDB study found that the parallel market network has actually deteriorated as indicated by a rise in the coefficient of variation of food prices in regional urban centers from 0.14 (1964), to 0.24 (1970), to 0.30 (1980).

It appears that this situation started to change after 1984, when measures were taken to deregulate the food market and relax trade controls. The coefficient of variation for maize and rice price in 29 urban markets fell from 0.30 (1980), to 0.29 (1984-85), to 0.20 (1985), and finally to 0.18 in 1986-87 (computed from data reported in URT, MDB; various years a).

Table 10. Availability of 25 foodstuffs in 20 urban markets, 1978 to 1982, Tanzania.

Year	Availability index[a]	Number of attempts
1978	0.154	4,650
1979	0.201	3,975
1980	0.216	4,425
1981	0.242	4,725
1982	0.283	5,025

[a]Probability that an attempted purchase is unsuccessful.
Source: Collier *et al.* (1985), p. 415.

Sales to official and open markets

Another impact of government intervention in the food market could be deduced from the share of marketed output that goes to the official and open markets (Table 11). From the late 1970s to 1983-84, about 20% of maize production was marketed. Of this marketed surplus, 25% was sold through the official market and 75% through open markets. The share of the marketed surplus going to the official market increased between 1984-85 and 1985-86 as a result of bumper harvests and a relative decline in the open market price of maize grain.

During the period, 50% of total rice production (paddy) was marketed, with 20% going to the official channel and 80% through open markets. The share of the marketed rice surplus going to the open market has been increasing continuously because prices on the open market were far above official prices. This is partly because the main paddy production areas (Morogoro, Shinyanga, and Mwanza) have a relatively high population and are near other major consumption centers such as Dar es Salaam, Dodoma, and the lake region.

Purchasing power

The ineffectiveness of food subsidies can be partly measured by the declining purchasing power of the minimum urban wage earners, and partly by the

Table 11. Share of marketed output of maize and paddy going to official and open markets, 1970s to 1986-87, Tanzania (%)[a].

Year	Maize			Paddy		
	Marketed surplus[a]	Market share Official	Market share Open	Marketed surplus[a]	Market share Official	Market share Open
Pre-1984c	20	25	75	50	20	80
1984-85	25	25	75	50	14	86
1985-86	25	36	64	50	13	87
1986-87	25	36	64	50	7	93

[a]Marketed surplus as a percent of total production. [b]Share of marketed surplus going to each market. [c]1970s to 1983-84.
Source: URT, MDB (various years a).

trend of official and open market consumer prices. Table 12 clearly shows that the purchasing power of the minimum urban wage has declined rather steadily, implying that individuals earning the minimum wage would have difficulty feeding their families--even if they had access to official food sources. However, few urban consumers have access to official food supplies since most households buy their food from open markets. Consumer food prices (Table 9) are partly higher because producer prices are higher and partly due to higher marketing cost due to the illegal status under which parallel markets operate. As a result, the purchasing power of many poor urban consumers has further eroded. Thus, attempts to control food prices at official levels have made food more, not less, expensive by increasing marketing costs of both the NMC and traders in the parallel market.

Government budget

Government intervention in the food market has also had budgetary implications. Subsidizing food production (ie., low input prices) and consumption (low consumer prices) has escalated government expenditure on subsidies. Government subsidies on fertilizer and maize flour have increased substantially from 1976-77 to 1983-84 (Table 13).

In addition to these subsidies, the government subsidized the increasing marketing losses of the NMC, resulting from increasing unit cost of marketing and handling a declining volume of officially marketed output. Unfortunately, the possibility of reducing the size of NMC as the volume of marketed output declined was not considered. Government subsidies to the NMC during the last three years prior to market liberalization were Tsh405 million in 1981-82, Tsh216 million in 1982-83, and Tsh318 million in 1983-84. Together with input and consumer subsidies, these subsidies were mainly absorbed by running budgetary deficits which increased almost annually.

In summary, government intervention in the food market did not achieve its intended goals. First, as a result of declining real producer prices and the decreasing availability of incentive goods, production growth slackened--increasing food shortages and making price control policy ineffective. This in turn contributed to the development of a parallel market. By 1983 the parallel market dominated the food market and the government actually tolerated its existence--even though it was still illegal. Second, since most consumers in urban and deficit rural areas did not have access to subsidized food, they had to turn to the parallel market where prices were considerably higher. Thus, the policy of enhancing accessibility to food among the poor through food subsidies turned out to hurt this group most. The regulated market could neither increase food availability nor help the target group get access to low-priced food. Third, subsidizing consumers

Table 12. Purchasing power in terms of maize flour and rice (kg of staple per day's wage) at official and open market prices, 1973-1987, Tanzania.

	Maize flour		Rice	
Year	Official	Open	Official	Open
1973	10.0	NA	4.8	NA
1974	9.1	NA	5.7	NA
1975	10.1	NA	3.2	NA
1976	7.2	NA	3.2	NA
1977	7.2	NA	3.6	NA
1978	7.2	NA	3.6	NA
1979	7.2	NA	3.6	NA
1980	12.8	NA	3.0	NA
1981	8.0	NA	3.7	NA
1982	8.0	3.85	3.7	1.38
1983	8.0	3.21	2.8	1.06
1984	3.4	1.89	2.0	0.77
1985	2.0	2.62	1.9	0.80
1986	NA	3.19	1.19	0.95
1987	NA	3.60	1.09	0.99

Source: URT, MDB (1987a)

Table 13. Government subsidies for fertilizer and maize flour, 1976-77 to 1983-84, Tanzania (Tsh million).

Year	Fertilizer	Maize flour
1976-77	49.693	49.349
1977-78	100.000	84.263
1978-79	135.400	562.350
1979-80	134.692	419.080
1980-81	136.450	125.151
1981-82	202.800	405.290
1982-83	195.970	216.550
1983-84	215.000	245.630

Source: URT, MFFP (1986).

and NMC losses since 1975 created budgetary pressure on the government which inhibited any attempts to increase real producer prices. All put together, by 1984 the government had sufficient reasons to liberalize the food market. The following section analyses market liberalization and its impact on food security.

MARKET LIBERALIZATION AND FOOD SECURITY

The previous analysis of government interventions in the food market and their impacts, relative to intervention goals, clearly shows that despite government intervention to set prices, the food market in Tanzania has remained by and large price-flex. The parallel markets, where market-clearing prices exert themselves, have dominated the dual market structure

Table 14. Official and parallel marketing margins for maize and rice, 1984-85 to 1986-87, Tanzania (Tsh per mt).

	Maize			Rice		
Price	1984-85	1985-86	1986-87	1984-85	1985-86	1986-87
Producer price						
Official	3,992	5,226	6,300	10,684	12,308	14,688
Open market	8,611	7,529	8,000	18,090	29,261	31,600
Ex-store cost						
Official	7,582	10,854	12,215	NA	NA	NA
Consumer prices						
Official	NA	NA	NA	13,950	16,750	28,880
Open market	10,780	9,650	10,357	36,070	37,570	36,810
Marketing margin						
Official	2,757	5,628	5,915	3,266	4,443	14,192
Private trader	2,169	2,121	2,357	18,000	8,320	5,210
Margin/producer price						
Official	0.69	1.08	0.96	0.31	0.36	0.94
Open market	0.25	0.28	0.29	1.00	0.28	0.16

Source: Computations based on data from URT, MDB (various years a).

that ensued from the intervention. In fact, of the major staples under government control, maize and rice--which account for 71% of total caloric intake in the diets (URT, MDB, 1985a)--are channelled predominantly through the parallel markets. Over the 1984-85 to 1986-87 period, parallel markets' shares of marketed maize and rice averaged 68 and 87%, respectively (Table 11). Despite costs associated with risks for contravening controls, private traders on average paid higher prices to producers and had significantly lower marketing margins than the official marketing system (Table 14).

Stimulus for liberalization

Pressure for liberalizing the food market stems from three sources. First, food scarcity arising from inadequate supplies invalidated price controls as parallel market prices for controlled grains became the effective prices. Second, because price controls were ineffective, the target group for food subsidies--the urban poor and rural food deficit households--did not have access to cheaper official supplies. Official supplies found their way to the less vulnerable and influential consumers; and quite often, via leakage to the parallel market, official supplies went to supplement trader's rental incomes through resales. Third, budgetary pressures increased as expenditure on subsidies escalated.

In addition to the increased cost of marketing and handling produce (stemming from increased unit costs as volumes declined without adjustment in the size of the official marketing agency), government incurred additional costs from its effort to support producer price increases via absorbing the growing losses of the official marketing agency (NMC). However, the budget-supported producer prices increases were outstripped by the high rate of inflation. This resulted in reduced real official producer prices, which further compounded the general problem of scarcity and increased switching away from official market sales.

Under these conditions, liberalization of controls become attractive to the government in order to reduce the increasing budgetary pressures. Also, it involved negligible political risk, in view of the ineffectiveness of the subsidy programme. The fact that most of the liberalization measures were initiated starting July 1984, before the adoption of the IMF programme in October 1986, partial supports this assertion.

Major liberalization thrusts

The government adopted two major types of market liberalization measures. The first category included direct, micro level modifications of existing interventions in the food market. These were generally geared towards modifying official prices so they more closely reflected scarcity prices.

Micro level policy measures

Micro level policy changes initiated since July 1984 have included the following measures:

- o The gap between official ex-store cost and consumer prices was narrowed. Consumer prices were raised by removing the consumer subsidies, especially for maize, in order to reduce budgetary deficits arising from official food trade. This was achieved rather quickly.
- o Real producer prices were raised by 5% per annum to correct for the historical decline and thereby induce greater production and increase the share of sales to the official marketing system. A key objective of this measure was to reduce scarcities by increasing supplies--thereby achieving sustainable national food security. This measure narrowed the gap between official and effective parallel market prices.
- o Bottlenecks to private trade in scheduled food crops were reduced. Road blocks were removed. Initially, private traders were allowed to buy and transport up to 500 kgs per lot, but in March 1987 the quantity restriction was removed. Under the current marketing system, the reinstituted Cooperative Unions buy from and sell to the NMC; and parallel to this system, private traders are also permitted to trade in food. The official system guarantees purchases at set floor prices.
- o Agricultural input subsidies were removed, with higher producer prices set to increase farm profitability and encourage farmers to adopt improved crop husbandry and innovation. This measure was partly introduced to shift the tying of rewards from manufactured fertilizer to the whole range of improvement efforts.

Macro level measures

The second category of market liberalization measures included macro-economic policy initiatives that were geared, among other things, to enhancing agricultural dynamism; and were included primarily in the Economic Recovery Programme adopted in July 1986. These included the following measures:

- o Partial import liberalization was instituted in July 1984, allowing individuals with access to their own foreign exchange to import incentive goods *inter alia* and sell them at market-clearing prices in order to increase the supply of incentive goods. This policy implied a major devaluation on the implicit exchange rate of imports which significantly increased profits to owners of foreign exchange and, as a result, reversed capital flight. The response to this move was greater than anticipated. Imports of goods totalled more than US$400 million in both 1985 and 1986, exceeding official export earnings (Ndulu and Hyuha, 1987; Ndulu, Lyakurwa, Semboja, and Chaligha, 1987). This measure significantly increased the supply of incentive goods and complemented the producer price increase effects on the supply of food. One visible effect was the disappearance of time-consuming queues for scarce commodities and the use of permits to acquire commodities previously in severely scarcity.

- o Exchange rate adjustments to correct for overvaluation started in earnest in July 1984 when the government devalued the currency by 31%, in terms of the Tanzanian shilling. Starting in March of 1986, Tanzania decided to quickly reduce the currency overvaluation. The shilling was rapidly depreciated from Tsh17 to the US$ in March of 1986, to Tsh40 in July of 1986. Thereafter, through a crawling peg, it was further depreciated to Tsh70 to the US$ by October of 1987.

This move, coupled with the decision to offer producers at least 70% of world market prices has significantly shifted the terms of trade in favour of agriculture. The implicit tax on agriculture resulting from overvaluation has been significantly reduced, raising the relative profitability of agriculture as a whole. Explicit taxation on local food producers--measured as the difference between c.i.f. cost of imports at official exchange rate and farm gate prices (official) of local supplies--was wiped out starting 1984, as farm gate prices rose sharply for maize and rice. However, the gap between the import cost (valued at the real exchange rate) and domestic farm gate prices continued to be significantly higher for maize than rice. For rice, the gap closed during 1985 as world market prices declined while prices to local produces continued to increase. These comparisons are made net of transfer costs in the domestic market.

IMPACTS ON THE FOOD MARKET: A PRELIMINARY ANALYSIS

Food supplies

Combined with good weather during 1985-86 and 1986-87, the above measures significantly increased food supplies, especially maize and rice. In 1984-85, an above average year, maize production reached an estimated 2.093 million mt and paddy production rose to 427,000 mt--an increase of about 8% and 20% over the 1983-84 level, respectively. In 1985-86, both maize and paddy production again increased rapidly. The maize harvest rose to an estimated 2.211 million mt (5.6% over 1984-85) while paddy output increased to 547,000 mt (28.1% over 1984-85). Estimates for 1986-87 show further production increases for these two major staples of 6.7% for maize and 17.7% for paddy (URT, MDB 1987a, p.9).

The estimated production increases reported above are well corroborated by consumer price movements in the open market, the dominant market reflecting scarcities. After reaching a peak during 1983-84, the average open market consumer prices for maize declined significantly during 1984-85 and have remained below the 1983-84 peak up to 1987. For rice, open market consumer prices more or less stabilized at the 1984 level. The decrease in the maize consumer prices and stabilization of rice prices occurred despite significant reductions in imports of both commodities (URT, MDB; 1985, 1986, 1987a).

Official purchases

Official maize purchases increased on average by 40% per annum over the period 1984-85 to 1986-87, partly in response to increased production and partly due to increases in the official producer prices, relative to open market producer prices. Although in absolute terms, open market prices generally remained above official throughout the period, the gap was closing rapidly. By 1985-86, the official price reached 70% of the open market prices, up from 50% in 1984-85. In 1986-87, official prices reached 78.8% of the open market producer prices (Table 14). These national averages hide the fact that in Ruvuma and Rukwa--the two remote and major surplus regions which account for over 30% of official procurement--official producer prices were *defacto* support prices, exceeding open market prices throughout the period.

Official rice purchases continued to decline, despite increases in production, mainly because the price gap between the two markets increased. While official producer prices were 59% of open market prices during 1984-85, they were a mere 42% and 46.5% of open market prices in 1985-86 and 1986-87, respectively. Over the period, open market producer prices increased by 74.7% while official prices increased by a mere 37.5% (Table 14). While the share of purchases from state farms increased during the period, smallholders significantly decreased their sales to official markets (URT, MDB; 1986a p.10).

Since March 1987, the NMC's maize stocks have reached record levels, estimated at over 200,000 mt. Slow local sales, due to both the fact that open market consumer prices were on average lower and export sales could only be undertaken at significant losses, has generated a liquidity crunch for official agents with far-reaching consequences. The liquidity tied up in nonmoving stocks has had backwash effects on continued purchases at official prices. This is worsened by the stringent credit ceilings of the recovery programme which affect not only continued purchases, but also credit to other sectors. Interest costs of tied up credit and storage losses compound the financial problems of official agencies. Projected increased margins are yet to be realized by the NMC since they are tied up in stocks. Whether they are ever realized will depend on whether or not stocks will be sold at a loss.

Producer income

In contrast, producers have achieved significant income gains. In high potential areas, estimated returns to labour per day from maize (valued at official prices) have increased by 112% over the period 1983-84 to 1986-87 (URT, MDB; various years a). For lowland paddy producers, estimated return to labour per day rose by 111% over the same period (MDB, 1984a). These income increases are predominantly price based, although production increases partially explain the increases.

In major maize surplus regions, especially Rukwa and Ruvuma, official producer prices were support prices, since they exceeded open market prices. As pressure from excessive stocks asserts itself, it is very likely that open market producer prices will decline (some current casual observation supports this assertion). Mandatorty purchases at above official open market prices by official agencies has, and continue, to constitute income transfers to producers.

Access to food

On the consumers' side, liberalization of cereal trade has improved access to food. Open market consumer prices for maize, as earlier noted, have declined. The share of open market purchases by consumers exceeds 75%. This is further strenghened by the fact that at the currently higher official consumer prices, private consumers hardly buy at all from official sources, as indicated by the decline in NMC sales since 1985-86 (URT, MDB; 1986a, p. 17). Combined with wage increases, the purchasing power of a day's minimum wage in terms of maize flour (at open market prices) increased from a low of 1.89 kg in 1984 to 3.60 kg in 1987 (Table 12). In contrast, the relative position of those who procure from official channels has definitely declined. Most of these purchases are institutional, usually subsumed in official budgets. For rice, the purchasing power of the daily minimum wage (at open market prices) increased from 0.77 kg to 0.99 kg over the same period. In the case of rice, open market consumer purchases are estimated to constitute 93% of total purchases (Table 11). Thus, the increase in real purchasing power for rice was totally accounted for by increases in minimum wages, since the consumer price of rice did not decline over the period.

Interregional movement of supplies

Interregional movement of supplies improved as road blocks were removed and private traders increased their participation in food trade. The decline in private trading margins, especially for rice partly reflects reduced costs previously associated with risks from violating controls (Table 14). Spatial variation in open market consumer prices significantly declined as shown by the steep decrease of coefficient of variation for these prices, from 0.29 in 1983-84 to 0.18 in 1986-87 (URT, MDB; 1986a). This had the effect of reducing prices in food deficit areas as supplies increased. Typical deficit areas such as Dodoma, Shinyanga, Kahama, and Tabora all have shown below national average increases in the food CPI since 1985-86 (URT, MDB; 1987a).

Agricultural sector income share

At a more aggregate level, a major shift has occurred in the share of income going to agricultural producers. This shift started in 1982 with the Structural Adjustment Programme which focused partly on raising prices to agricultural producers. It has accelerated since 1984 due to the concerted effort to raise real producer prices, which implied faster rates of increase in nominal prices. As pointed out earlier, this resulted from less reliance on budgetary support, removal of food subsidies, and adjusting the exchange rate.

National accounts data indicate that the share of nominal income going to agricultural producers jumped from an average of 43% from 1976 to 1981, to 50% in 1982, and then continued to move upwards--reaching 58.9% in 1986 (Table 15).

Nominal income of agricultural producers rose at an average rate of 36.9% over the period 1984-1986. If this rate of increase is compared with the 33.9% average annual increase in the CPI (URT, MDB; 1986a), agricultural pro-ducers' real income increased at a rate of 3% over the period. In contrast, during the 1980-84 period when nominal income rose by an average of 25.5% per annum, the average annual rate of inflation was 27.9%. This implied a decline in real income for agricultural producers of 2.45% per annum.

The increase in real income during the 1984-86 period was partly due to increases in nominal incomes (explained mostly by increases in producer prices) and partly to real growth in output, although producer prices had a stronger influence in explaining changes in nominal incomes.

The increase in agriculture's share of national income is strongly explained by agricultural prices, relative to non-agricultural prices, which rose by 31.7% over the period. Agricultural producers' relative prices were computed as the ratio of GDP deflators for agriculture and nonagricultural sectors.

Table 15. Nominal agricultural incomes and relative profitability of agriculture, 1976-1986, Tanzania.

Year	Nominal agricultural GDP			Relative price of agricultural to nonagricultural activities[a]
	Value (Tsh million)	Growth rate (percent)	Share (Percent)	
1976	9,046	NA	42	100.0
1977	11,131	23	44	106.1
1978	12,506	12	44	113.6
1979	14,728	18	44	128.2
1980	16,636	13	44	122.8
1981	20,338	22	46	128.4
1982	26,449	30	50	152,1
1983	32,737	24	54	167.4
1984	41,295	26	54	180.5
1985	56,235	37	57	196.9
1986	77,396	38	59	220.5

[a]Ratio of agricultural GDP implicit deflator to non-agricultural GDP deflator. NA indicates data not available.
Source: URT (1986b).

CONCLUSION

These results indicate that the rural population as a group increased their access to food through increases in real income. Given an income elasticity of demand for food of 0.89 for rural households, food consumption in these households very probably increased by 2.67% per annum over the 1984-86 period.

The picture for the urban households is more difficult to discern in view of the likely growth of informal sector incomes. However, national accounts statistics indicate that the nominal incomes of non-agriculturalists increased by 24.04% per annum over the 1984-86 period. When compared to the annual average rate of CPI of 33.9% over the same period, the real incomes of this group declined by 6.01% per annum. However, the food component of the

CPI registered a significantly lower rate of increase--25.82% annually (URT, DEVPLAN) 1986a. Thus, in terms of consumption, real income decreased by only 1.78% over the whole period. The rate of decline in real income of non-agriculturalist was significantly reduced, compared to the 1980-84 situation. During that period, nominal incomes increased at an average rate of 12.65%, compared with the average inflation rate of 27.9% (URT, DEVPLAN, 1986a). This implied an annual rate of decline of real income of 15.25%.

These preliminary estimates of the impacts of market liberalization on food supplies, consumption, and income were supported by two consecutive years of good weather. They indicate generally increased availability of food, improved access to food in rural areas, and some decline in the rate of deterioration of urban real income in terms of food. Furthermore, the geographical flow of food supplies improved, as indicated by the reduced price dispersion. In the next phase of the study, we will undertake a more micro level analysis of impacts, taking into account income distribution and the identification of vulnerable groups.

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MARKET LIBERALISATION AND FOOD SECURITY IN MALAWI

B. Kandoole, B. Kaluwa, and S. Buccola[1]

INTRODUCTION

Since independence, Malawi has emphasised the smallholder and estate sectors. They differ in terms of land tenure, type of crops grown, credit institutions, market access, and availability of extension service rather than in farm size. Farmers under communal land tenure cannot grow burley tobacco, are serviced by the Agricultural Development and Marketing Corporation (ADMARC), and have access to government extension services. On the other hand, estate farmers under freehold or leasehold can obtain commercial bank credit. Hence, the smallholder sector produces food and a limited number of export crops while the estate sector has concentrated on tobacco, tea, and sugar.

During the 1960s and 1970s, estate production grew much faster than smallholder output. Exports from estates expanded at an annual rate of 15% while smallholder exports recorded very little growth. The estate's share of exports increased from 32% in 1967 to 65% in 1979 and reached 80% in 1981-82.

Emerging problems

In the late 1970s and early 1980s, significant problems emerged. Malawi's terms of trade fell by 40%. Agricultural production suffered from drought, falling export volume, and required maize imports for the first time in virtually a decade. In addition, disruption of the transport system through Mozambique forced Malawi to use more costly alternative routes.

The primary causes of Malawi's economic difficulties were transport problems and serious deterioration in the country's terms of trade. Yet, the crisis also revealed important weaknesses in the economy and in the agricultural development strategy. Malawi's exports are heavily concentrated on the three estate-produced commodities. Unfortunately, each commodity faces uncertain supply and demand growth prospects for the following reasons:

- o A shortage of suitable land severely limits any increase in output from extended acreage. Expansion will have to come from higher yields.

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- o A growing shortage of fuelwood threatens flue-cured tobacco and tea production.
- o A shortage of credit may become a serious constraint to expanding burley and flue-cured tobacco production.
- o World market prospects for tobacco, tea, and sugar are poor.
- o During the recent past, expanded maize production has made a substantial contribution to growth, but high transport costs and low market price limit prospects for exporting maize.

Government's response

Due to these and other problems, government has put added emphasis on smallholder food production. During the past six years, the government has taken significant steps to improve the agricultural marketing and pricing environment; particularly improving the methods of setting agricultural prices in order to increase smallholder returns and improve incentives for production and diversification.

ADMARC's operations were also improved by introducing a new management structure, rationalizing its investments through swaps with other large corporations, and drawing up of comprehensive divestiture and operational plans. Fertilizer procurement and distribution were strengthened and a four-year phase-out of the fertilizer subsidy was implemented.

The rest of our discussion emphasises the smallholder sector for two reasons. First, since this sector is the main producer of food crops, any analysis of market liberalisation and food security must therefore concentrate on it. Second, the estate sector is already liberalised since it trades directly on world markets.

MAIZE PRICING POLICY

History of controlled marketing

Over the past 40 years, five different institutions have been created to organise agricultural marketing in Malawi.

<u>The Maize Control Board</u>

The origin of official control over food marketing can be traced to 1949 when, in response to a drought, 23,608 mt of famine relief food (over half of it maize) were imported. In that year, the Maize Control Board was established to control the marketing of maize grown on trust lands and to set a guaranteed price. Although this price was one penny per pound for a fairly long time (1949 to 1956), it significantly increased the importance of maize production as a cash crop, especially in the Central Region.

The Produce Marketing Board

In 1952 the Maize Control Board was superseded by the Produce Marketing Board (PMB). It wàs given wider powers, including authority to purchase other crops such as groundnuts and beans. Maize and nonmaize purchases continued to grow through 1954, followed by a decline in 1955-56. Since surpluses were exported to Europe, falling world prices in the late 1950s led to a reduction of the maize producer price to 0.67 pence per pound in 1957. Interestingly, the price fall led to an increase in private trading activities and an immediate reduction in the quantity of grain offered to the board; from 29,056 mt in 1956 to only 4,903 mt in 1957 (British Government, 1959). The deficiency forced the board to purchase additional quantities from private traders at higher prices.

The Agricultural Production and Marketing Board

The price drop was instituted by the Agricultural Production and Marketing Board (APMB), a 1956 amalgamation of the PMB, the Native Tobacco Marketing Board, and the Cotton Marketing Board. The APMB was given the task of providing a stable and efficient marketing system for the main cash crops produced on trust lands. In addition to its marketing function, the board was charged with providing extension advice during the growing season.

Through 1956, official policy was to pay growers a price that provided a "reasonable return". Price policy changed in 1957 when minimum uniform preplanting prices were implemented. Producer prices were intended to be related to world market prices. Stabilisation around a market trend line was to be accomplished through a buffer stock. The board promised to purchase all produce offered at the official price. The board's primary purpose was to act as the government's agent in supplying industrial and urban markets and in maintaining a strategic reserve against the possibility of crop failure.

The Farmer Marketing Board

APMB was succeeded by yet another statutory body, the Farmers Marketing Board (FMB). The functions of the new board were more extensive than its predecessors. It was responsible for:

- o marketing, processing, and disposing of agricultural products;
- o providing adequate price stability in order to protect farmers from world price fluctuations and increased agricultural output;
- o providing storage facilities for food reserves on behalf of government; and
- o subsidising agricultural inputs to increase yields.

Agricultural Development and Marketing Corporation

In 1971 the Agricultural Development and Marketing Corporation (ADMARC) assumed FMB's responsibilities. By this time, the board had accumulated 52 principal storage depots throughout the country and hundreds of temporary bush markets. According to the *Agricultural Development and Marketing Corporation Act of 1971* (Ch. 67.03 Section 5), ADMARC's objectives were similar to its predecessor's. The difference was that ADMARC was to take a more aggressive role in supporting agriculture. Specifically, the new board was charged with buying, storing, processing, adapting for sale, distributing, insuring, advertising, and transporting all products grown on customary lands for sale. In addition, the act mandated the corporation to sell produce for domestic consumption at prices that covered marketing costs; except when the government felt that a lower price was in the national interest. At any rate, government would reimburse ADMARC for the difference between the low price and the cost recovery price.

Impact of price levels

Actually, the selling prices have nearly always been below cost recovery levels. Consumer-producer price differences have been insufficient to cover marketing costs, especially the cost of transporting produce from rural markets to urban centres (Table 1). Maize has incurred losses in most years because of the subsidy policy, as indicated by net profits/losses on crops traded (Table 2).

Because cash crops are exported at world prices, Malawi's rural population has paid what Kydd and Christiansen (1982) have called an implicit tax (Table 2). Recently trading profits in tobacco and groundnuts have exceeded losses in maize and rice. The latter losses are incurred principally due to subsiding workers paid low wages in urban areas.

Private trading

Private trade in commodities produced by smallholders preceded official marketing institutions and has always been accepted. Rules have been established restricting activities of large and non-African traders, including upper limits on quantities of produce a single trader may purchase. Little information has been gathered about the private marketing subsystem, except that the Ministry of Agriculture and the National Statistical Office collect price-related and private trader information at a very limited number of localities.

Status of African traders

The *APMB Ordinance of 1957* exempted African traders from restrictions against trading produce with fellow Africans. However, since margins

Table 1. Mai-e prices, 1967-68 to 1986-87. Malawi[a]

Year	Free market price[b]	ADMARC Producer price	ADMARC Consumer price
1967-68	39.70	20.00	40.00
1968-69	40.50	20.00	40.00
1969-70	52.70	20.00	40.00
1970-71	45.10	30.00	40.00
1971-72	48.90	30.00	40.00
1972-73	48.40	30.00	40.00
1973-74	64.20	30.00	50.00
1974-75	83.50	40.00	66.00
1975-76	91.50	50.00	66.00
1976-77	85.00	50.00	66.00
1977-78	86.20	50.00	66.00
1978-79	94.70	50.00	90.00
1979-80	122.20	66.00	90.00
1980-81	155.50	66.00	110.00
1981-82	162.60	111.00	130.00
1982-83	190.10	111.00	140.00
1983-84	196.50	122.00	140.00
1984-85	195.60	122.00	140.00
1985-86	246.50	122.00	148.50

[a] Prices are in Kwacha per mt.
[b] The free market price is based on monthly average at Blantyre and Lilongwe Markets.
Source: ADMARC, (various years) and *National Statistical Office*

Table 2. ADMARC net profit/(loss) on crop trading, 1974 to 1985 Malawi[a]

	Financial year ending 31st March											
Crop	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Tobacco	2.56	4.91	10.61	15.76	25.86	4.22	2.71	3.23	9.14	18.62	13.36	15.73
Cotton	1.45	3.16	0.46	1.91	1.41	1.21	0.46	(0.79)	2.75	0.72	(0.25)	(1.21)
Groundnuts	1.77	1.08	1.27	5.99	4.50	2.22	3.75	4.23	3.28	0.78	0.28	(0.90)
General produce	0.61	1.09	0.54	1.71	1.38	0.54	(1.10)	(0.45)	(0.52)	(1.01)	(0.89)	(0.76)
Rice	0.41	0.57	(0.03)	(1.08)	(0.78)	(0.68)	(1.56)	(1.40)	(0.66)	(1.12)	(0.46)	(1.18)
Maize	1.58	0.22	(2.87)	(1.61)	(2.33)	(3.32)	(4.18)	(4.49)	(5.13)	(5.77)	(5.49)	1.17
Total	8.11	11.03	9.98	22.68	30.04	4.19	0.08	0.33	8.86	12.22	6.55	12.85

[a]Figures are in millions of Kwacha. Numbers in parentheses indicate losses.
Source: ADMARC (various years).

between producer and consumer prices have been small, it has not been worthwhile for large traders to participate in food marketing. The increase in private maize trade in 1957 following APMB's price reduction indicates the lively state of private trade, even before independence. The *Jack Report* (Federation of Rhodesia and Nyasaland, 1960) welcomed this development, noting that the increased number of middlemen engaged in maize trade would offer competition, reduce excess board profits, and improve farmers' living standards.

The trading network

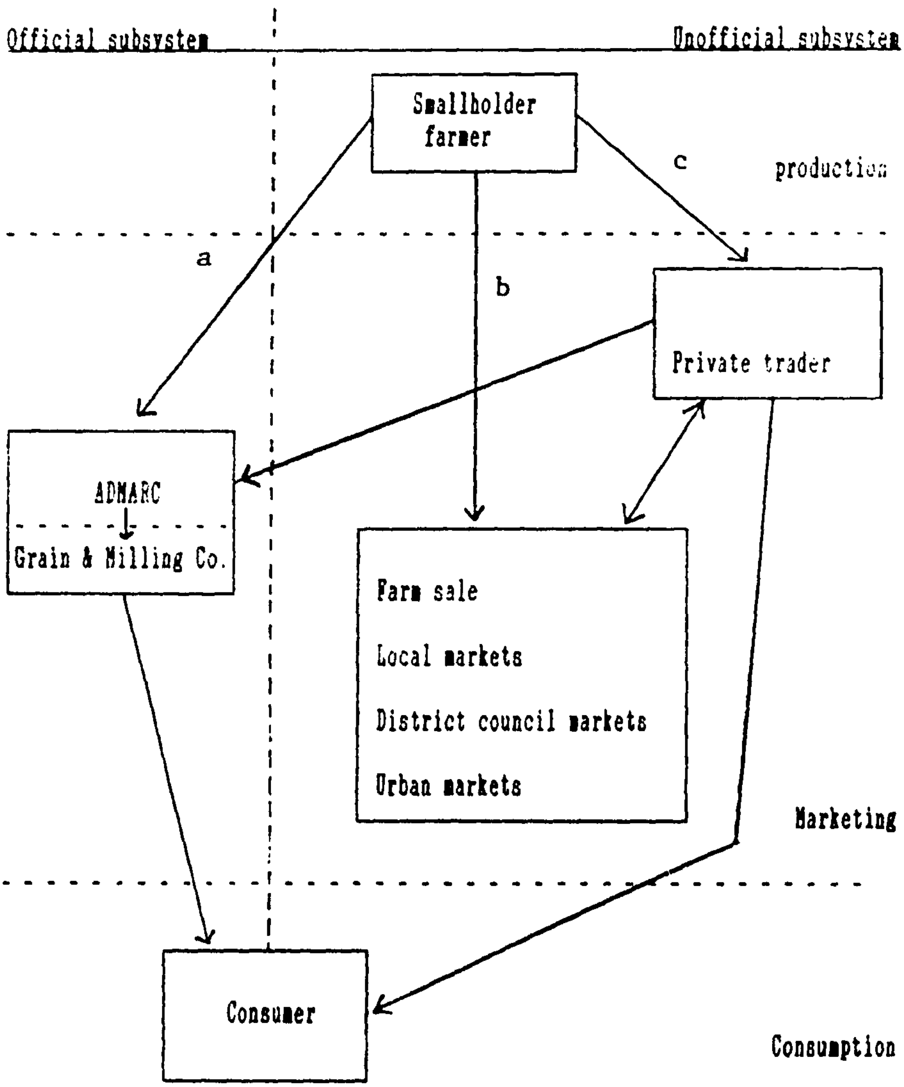
Figure 1 shows the relationships between private trade and the marketing board subsystems in Malawi. Farmers sell maize to ADMARC, consumers, or middlemen. ADMARC may purchase maize grain from middlemen or producers, and may sell to either consumers or the Grain and Milling Company for processing into flour. Maize sold by smallholders to consumers in local district council markets is in whole or processed flour form. Finally, middlemen normally sell directly to consumers except, when commissioned they may also sell to ADMARC.

Contribution of private traders

Although statements of marketing board objectives give the impression they are monopsonists in maize marketing, the record suggests otherwise. There is evidence that ADMARC has often handled a small proportion of the traded maize surplus--6% in 1970, 26% in 1973, and 13% in 1975 (Malawi Statistical Yearbook; 1973, 1977, and 1978). The rest has been handled by private traders in various market places; including farmgate, local markets, district council markets, and urban markets. In addition, a 1982 Ministry of Agriculture survey indicates that some of the numerous markets at which ADMARC operated were shared by private traders and that there were other markets at which only private traders operated. Areas in which only ADMARC was supposed to operate were typically remote districts far from highly populated urban centres (i.e., Chitipa and Nsanje), or districts specialising in cash crops rather than maize (i.e., Nkhata Bay, Karonga, Nkhotakota, Kasungu, and Salima). In 10 of the remaining 17 districts, markets at which only private traders or both ADMARC and private traders operated, they were in the majority (Quinten and Sterkenburg, 1975). Although some private traders were licensed to buy from smallholders and sell to ADMARC, most operated independently to supply their own customers.

Two reasons account for the high proportion of private maize trade. First, ADMARC sets both producer and consumer prices before the planting season and any produce sold to them is at the producer price. If producers

Figure 1. Official and unofficial maize marketing subsystems in Malawi.



sell directly to consumers, either as grain or flour, they can avoid selling at official consumer prices since the latter do not apply to the small measuring instruments used in local markets. Second, consumers prefer buying directly from farmers because the latter mainly stock local varieties while ADMARC mostly handles hybrids. Local varieties are favoured over hybrids because of their superior taste, poundability, and storage ease.

Table 1, which depicts differences in prices between the official and unofficial trade, shows that although the absolute gap between free market and official consumer price has widened over time, but there has been little trend in the ratio of the two prices (averaging around 1.25). Only recently has the ratio widened considerably. Until 1987, private trade was only permitted in small quantities. Thus, the large volume of private trade implies that many individuals have been actively involved.

EMERGING PROBLEMS IN MAIZE PRICE AND MARKETING POLICY

Government controls ARDMARC's farm maize purchase price, domestic selling price, input prices, and export and import quantities. Thus, the government has used the marketing corporation as its principal instrument for influencing agricultural price and storage policies.

Price policy objectives

The most commonly stated objectives of Malawi's maize producer price policy have been to: (a) provide incentives for smallholders to produce enough maize to meet domestic demand (i.e., to maintain maize self-sufficiency); (b) guarantee a steady cash income for smallholder farmers who comprise 85% of the population; (c) help implement the government's policy of diversifying agricultural production; (d) maintain an adequate return to ADMARC's operations (i.e., to keep costs somewhat in line with revenues which implies producer prices must respond to export parity prices, domestic selling prices, and ADMARC's operating costs); and (e) never reduce nominal maize prices.

On the other hand, the stated objectives of maize consumer price policy have been to: (i) enable wage earners to consistently purchase enough maize for a calorie-adequate diet and (ii) maintain an adequate return to ADMARC's operations (i.e., to keep revenues in line with costs which implies selling prices must respond to import parity prices, farm purchase prices, and ADMARC's operating costs). Although unstated, we assume that a third objective, comparable to enabling wage earners to purchase a calorie-adequate diet, might be necessary: (iii) discourage consumers from wishing to purchase no more than what is domestically available (i.e., maintaining maize self-sufficiency).

In addition, government--through ADMARC--would like to maintain a strategic maize reserve, sufficient to satisfy demand in low production years without resorting much to imports. The silos complex built in 1981 to house the strategic maize reserve holds 180,000 mt. Although, an optimal reserve level has not been identified, it would clearly depend upon the domestic buying and selling prices that prevail (Buccola and Sukume, 1988). The best strategic reserve must be high enough to avoid excessively large imports in lean years and small enough to avoid excessively large storage costs.

Conflicts among objectives[2]

No price or stock policy can completely satisfy all these objectives because they usually conflict with one another. Producer price policy intentions themselves can be self-conflicting. For example, stabilising cash incomes (b) requires averaging out export parity prices over a number of years. But current or averaged export parity prices may be too low to induce maize self-sufficiency (a), or the prices may be so high that the country becomes a consistent maize exporter. This in turn may conflict with the diversification objective (c). Any one of objectives (a) through (d) may from time to time require reductions in nominal prices, a violation of objective (e).

Similar conflicts may occur among consumer price policy objectives. Consumer prices sufficient for a universally calorie-adequate diet (i) are often lower than those needed to maintain acceptable ADMARC operating revenue (ii), and perhaps too low to keep average domestic consumption below average domestic production (iii). Finally, consumer prices adequate for objective (i) may collectively be inconsistent with objectives (d) and (ii) (i.e., they may not generate an adequate return to ADMARC's operations).

Faced with these dilemmas, it is no wonder that maize price policies have undergone several changes through the years. For example, it was often argued that low producer prices in the 1960s and 1970s were beneficial in that they discouraged farmers from selling so much of their crop at harvest, that they would have to buy some of it back later in the year. Yet, this reasoning is flawed because the seasonal pattern of producers' sales would depend upon expectations of seasonal price changes, not average annual prices.

Declining ADMARC purchases

As a result of the low price, ADMARC's domestic maize purchases in the 1960s and 1970s were rather small (Table 3). Many farmers may have sold

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[2]See appendix 1 for technical discussion of price administration.

Table 3. ADMARC maize transactions, 1969 to 1986, Malawi.

	Farm purchases		Domestic sales		Foreign trade	
Year	Price(K/mt)	Quantity (000 mt)	Price(K/mt)	Quantity (000 mt)	Imports (000 mt)	Exports (000 mt)
1969	20.00	85.83	40.00	127.05	NA	0
1970	20.00	54.03	40.00	59.48	NA	0
1971	30.00	36.42	40.00	51.65	NA	4.60
1972	30.00	37.01	40.00	34.00	NA	36.84
1973	30.00	64.59	40.00	50.29	NA	36.25
1974	30.00	60.12	50.00	90.76	NA	31.00
1975	40.00	65.53	66.00	NA	NA	0
1976	50.00	29.16	66.00	NA	NA	0
1977	50.00	65.11	66.00	NA	NA	0
1978	50.00	89.84	66.00	NA	NA	0
1979	50.00	120.30	90.00	NA	NA	0
1980	66.00	82.40	90.00	150.70	11.20	0
1981	66.00	91.21	110.00	121.40	56.10	0.05
1982	111.00	136.59	130.00	113.90	1.20	0.05
1983	111.00	246.09	140.00	74.80	0.05	76.09
1984	122.00	244.92	140.00	193.30	0	130.73
1985	122.00	296.44	140.00	85.70	0	45.66
1986	122.00	272.28	148.50	163.80	0	32.02

NA: indicates data not available.
Source: ADMARC, (various years) Malawi Government, Ministry of Finance, (1986)

their maize to small private traders or in local markets where the crop brought a better price than the one offered by ADMARC. This means the policy could not have been as effective as desired in discouraging food sales. In an effort to boost maize purchases and increase rural incomes, the government increased producer price for the 1982 marketing year by 66%. This had the desired effect of sharply increasing smallholder maize sales to ADMARC and of increasing stocks above those needed to fill the new silo complex. ADMARC's operating and financial performance was strong until 1978, but weakened near the end of the decade. By 1982, ADMARC was unable to finance fertilizer procurement for the smallholder sector. This downfall was largely a result of policies discussed below:

Expansion into nonmarketing areas

A major source of ADMARC's recent difficulties has been its expansion into fields unrelated to agricultural marketing, which has diverted financial and managerial energies from its principal line of work. The nonmarketing activities generally have brought low asset returns. Plans are underway to resolve this problem by requiring ADMARC to revert to its primary function of providing marketing services to the smallholder subsector; divest itself of its nonagricultural, nonmarketing investments; and rehabilitate its investments in agro-processing subsidiaries.

The move will require a legal change because the *Agricultural Development and Marketing Corporation Act of 1971* (Cap. 67.03) gave ADMARC the power to:

> Assist any organisation, government, corporation, company or co-operative society with capital or credit by means of investment in stock, shares, bonds, debentures or debenture stock, or with other ways or resources for the prosecution of any works, undertakings, projects, schemes or enterprises relating to the development or improvement of the economy of Malawi.

Strategic maize reserve

Until the government's 1981 decision to build a strategic grain reserve, ADMARC's farm maize purchases were usually roughly equal to domestic sales. The strategic maize reserve project was very costly. The capital cost of the silo complex was K15.9 million, requiring an annual interest payment of K1.0 million in 1985-86. A silo full of grain at 1986 purchase prices costs K22.0 million and does not bring any immediate return to ADMARC. Annual interest charge on the inventory value would, at a 15% interest rate, be K4.3 million. Finally, the annual maintenance cost is K420,000. All these costs are borne directly by ADMARC (Malawi Government, 1986).

ADMARC's problems have been aggravated by the large surplus stock it has held in addition to the strategic grain reserve. Substantial price increases since 1981 greatly increased ADMARC procurement, resulting in a surplus stock in excess of the 180,000 ton strategic reserve (Table 3). While it was possible to export surplus maize at attractive prices in the early 1980s due to adverse growing conditions in much of the surrounding region, surpluses in neighbouring countries are now depressing regional prices and making exports less profitable.

Fertilizer subsidies

ADMARC has subsidised farm inputs, such as seeds and fertilizer, by selling them at prices below the purchase price, plus transport and handling cost. The resulting losses show up on operating statements. For example, an important aspect of the Ministry of Agriculture's *National Rural Development Plan* is to encourage smallholders to fertilize maize (particularly composite and hybrid varieties) in order to increase yields; thereby releasing land for cash crop cultivation without violating the government's maize self-sufficiency objective. In addition, fertilizing smallholder cash crops such as tobacco and cotton would improve yields and gross margins. Because there is very little unused arable land in Malawi, the plan's success depended on convincing farmers to adopt hybrid maize. Only the hybrids respond well to fertilizer, so only they can raise yields sufficiently to release more land for foreign exchange-earning cash crops.

The policy successfully increased fertilizer use. Between 1972-73 and 1986-87, smallholder fertilizer purchases increased by 183%, from 23,750 to 67,290 mt. In addition, Kirchner and Kandoole (1986) found that the fertilizer subsidies succeeded in promoting fertilized hybrid maize as a cash crop, particularly on larger farms. However, the programme failed to encourage farmers to substitute local maize (planted for subsistence), for hybrid. Therefore, it failed to release additional land for cultivating nonmaize cash crops.

Promoting hybrid maize as a subsistence crop appears to have failed for at least two reasons. First, hybrid has different pounding and taste characteristics than local maize and is more difficult to store without losses. Therefore, there exists a consumer preference for traditional maize varieties. Second, substantial maize producer price increases made maize a highly profitable cash crop. Farmers responded to the increased price incentives by producing more maize for sale. As a cash crop, hybrid maize has impeded the expansion of the other crops that the diversification efforts were designed to promote. Since hybrid maize is more responsive to fertilizer than are tobacco, cotton, and groundnuts, Kirchner and Kandoole

(1986) argue that removing the fertilizer subsidy will actually promote the government's diversification objective.

MARKET LIBERALISATION

The new *Agriculture (General Purpose) Act of 1987* essentially eliminates ADMARC's quasi-monopsony in the domestic market. It allows individuals in the private sector to deal in produce at 1,139 markets throughout the country, some of which formerly were only operated by ADMARC. The new arrangement differs from the past in that traders are now allowed to buy and sell any quantities they wish. Important features of the liberalised marketing plan are:

- Private traders must be licensed annually to operate in specified markets. This provision may be used to bar unethical traders, but possibly could also be employed to limit competition for ADMARC at certain times and places.
- Only Malawi nationals or businesses owned by Malawian citizens are eligible for licenses. This effectively controls operator size and reduces the possibility of market domination by a few foreign firms.
- Minimum producer prices will be announced annually and ADMARC will be a ready buyer at these prices. ADMARC's role will be limited to operating a buffer stock to maintain long-run producer price stability.
- Maize exports will be controlled through an export licensing system. To ensure food self-sufficiency, the government will monitor private traders' food exports. During periods of scarcity, it may be difficult for some traders to obtain export licenses.
- Traders must submit monthly statements detailing prices paid and received and amounts bought and sold.

Likely aggregate effects

One advantage of a move to private trading is that it will tend to stabilize incomes rather than prices. Under the government's price policy, pre-planting prices are paid, irrespective of actual harvest size. Thus, farm incomes have changed in proportion to harvest volumes. Under a freer market, prices will tend to be high with poor harvests and low in good years, an income stabilizing factor. Moreover, private traders tend to buy and hold when maize is plentiful and release stocks during seasons of scarcity, smoothing out interseasonal variability in stocks and scarcity prices. This may not work well in all years. Some argue that private traders presently are holding "excessive" stocks at the same time that ADMARC has imported maize from its neighbours. Traders' exact holdings are unknown and the wisdom of their collective actions is still to be tested. Possibly, traders are undergoing a learning period.

The government will be able to affect ADMARC's participation in maize markets through changes in its guaranteed minimum produce price. As long as the minimum price stays relatively low, ADMARC will make maize purchases only in high production years when free market prices are low and close to the ADMARC price. Hopefully, increased competition with ADMARC will drive down marketing costs, as traders seek to reduce unnecessary expenditures in their search for higher income. In the long run, this should increase real producer prices.

At the same time, factors which we have thus far held constant will also change. First, fertilizer prices will increase with the four-year subsidy phase-out. This will reduce fertilizer purchases and hence maize yields, reducing quantities that farmers offer traders at any given producer price. Yield reductions will likely encourage farmers to switch to less fertilizer-responsive crops such as groundnuts, further reducing maize supply. Liberalisation-related maize price increases may be viewed as dampening this supply reduction effect to some extent.

Second, government is also legalizing private trade in groundnuts, pulses, and other nonmaize foods. If liberalisation increases long-run producer prices for these commodities as well, the net effect on maize-nonmaize price ratios will be uncertain. For example, the effect would depend on the degree of trader competition in maize, relative to nonmaize products. The long-run effects of liberalisation on consumer maize-nonmaize price ratios are similarly difficult to predict *a priori*.

Likely disaggregated effects

Together, these observations suggest market liberalisation will promote long-run food security--provided government maintains adequate minimum producer prices. Liberalisation implies a long term reduction in government subsidies to the food sector, which will free resources for other productive enterprises. However, reducing subsidies will hurt poor consumers and farmers with inadequate resources to respond to the new incentives created by liberalisation. Thus, there is a need to investigate the welfare impacts of these policies. One approach is to develop profiles of smallholders who are most nutritionally at risk and to investigate likely short and long-run effects of liberalisation on these farmers. Some salient characteristics of smallholders that will serve as a background for such a study are discussed below.

A Ministry of Agriculture survey (1985) indicated that 23% of the sampled rural households had landholdings of less than 0.5 ha. (Table 4).

Table 4. Distribution of smallholder farm size and related descriptors, 1985, Malawi.

	Holding size category (Hectares)						
	0.0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	Above 3.0
Basic Data							
Share of all holdings (%)	23.0	32.3	19.9	10.9	6.3	3.5	4.2
Share of total cultivated area (%)	6.2	20.9	21.3	16.3	12.2	8.3	14.8
Mean holding size (hectares)	0.3	0.7	1.2	1.7	2.2	2.7	4.0
Mean family size	3.5	4.3	4.8	5.0	5.6	6.0	6.3
Household Income (K/hh)[a]							
Value of crop production	53.30	130.50	225.70	308.30	405.14	482.47	733.22
Livestock	6.46	5.74	10.04	11.55	26.64	38.51	48.63
Total from agriculture	59.76	136.24	235.74	319.85	431.78	520.98	781.85
Off-farm activities	26.58	22.80	19.64	18.06	20.93	21.80	14.50
Remittances	4.79	6.32	7.66	5.21	6.95	5.96	8.68
Total income	91.13	165.36	263.04	343.12	459.66	548.74	805.03
Agricultural Inputs							
Family labor (mandays)	381	480	569	593	712	762	822
Hired (mandays)	8	12	20	25	42	58	94
Total labor available[b]	389	492	589	618	754	820	916
Fertilizer use (kg/hh)	6	12	33	59	87	114	146
% receiving any extension service (%)	13	18	28	41	38	52	47
Food Balances							
Calorie requirement	3715	4582	5138	5357	6062	6472	6878
Food production	899	2033	3356	4715	5987	7524	10997
Calorie balance (absolute)	-2816	-2549	-1782	-642	-75	1052	4119
Calorie balance (%)	-76	-56	-35	-12	-1	16	59

[a]kwacha/household. [b]kilograms/household
Source: Ministry of Agriculture (1985)

The average holding was just over 1.0 ha. Only 14% of the households had greater than 2.0 ha. this 14% operated about 35% of the cultivated land. The household income section of Table 4 shows that income from all farm sources rises with size of landholding. However, there is roughly an inverse relationship between off-farm income and farm size, suggesting that some individuals with small holdings may work for those with larger ones during part of the year. Average income of a household with more than 3.0 ha. is nine times that of someone with less than 0.5 ha., and five times that of someone with 0.5-1.0 ha. Households with smaller holdings also have less family and hired labour, use less fertilizer, and receive less frequent extension services than those with larger farms.

All these factors contribute to poor food balances for individuals with smaller farms, as shown by the food balances section of Table 4. Those with the smallest holdings have a 76% home-produced calorie balance deficiency; and this deficiency decreases with size of holding. Only households with more than 2.5 ha. (7.7% of those sampled) are net food sellers. These are the farmers who earn higher incomes when farm prices rise. The remainder (92.3%) are unlikely to benefit immediately since they will have to buy any supplementary food at higher prices. A crucial factor which this table does not explicitly show is the absolute ability of households to provide a calorie adequate diet out of home production and off-farm income. However, it is clear the government should target food assistance towards those with the smaller landholdings.

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Appendix 1

TECHNICAL DISCUSSION OF PRICE ADMINISTRATION

A theory of administered producer prices

Experience has shown that it is difficult to control maize prices intelligently, even if it were possible to enforce the controls in the face of extensive petty trading. The difficulty arises because prices are meant to satisfy two kinds of objectives. First, they are meant to influence quantities of maize produced, marketed, and consumed. Second, they are intended to affect the real incomes and risks faced by producers, middlemen, and consumers. it is not easy for government to know how such quantities and incomes should be distributed, let alone how a given set of prices will distribute them.

Consider, for example, the simple case where there are only quantity-type objectives. Government has a target maize quantity, Q^o, which it wishes to purchase in the next marketing year. The target may be determined as:

(1) $$Q^o = E(Q^d) + C[Var(Q^d), P^w] - S$$

where $E(Q^d)$ is the quantity consumers are expected to wish to purchase at the given selling price;

C is a safety margin (reflecting the variability of consumer demand and perhaps the wish to export some maize, itself a function of world price (P^w);

S is a carryover stock from the previous season.

In order to obtain Q^o from farmers, a producer price P^f must be paid that will induce farmers to sell Q^o. Ignoring risks, let the smallholder maize supply function be:

(2) $E(Q^s) = f(P^f, \ Z)$

where Z is the other factors (e.g. weather and groundnut prices) affecting supply.

Suppose now the maize demand function is:

(3) $E(Q^d) = h(P^s, \ X)$

where P^s is maize consumer price and X represents other demand factors such as wages. Substituting (3) into (1), solving (2) for P^f, then substituting (1) into the inverted form of (2) gives:

(4) $P^f = f^{-1}(Q^o, Z) = f^{-1}[(h(p^s, \ X) + C - S), Z].$

That is, the desired producer price depends upon all the factors affecting domestic supply and demand (including the consumer selling price), world prices, and reserve stocks. A similar model can be developed to show the complexity of administering consumer prices.

Producer price administration in practice

A feeling for how the Malawi government has tackled this difficult problem can be had by regressing ADMARC producer and consumer prices against some of the factors shown in equation (4). Specifically, we used linear ordinary least squares to regress the following:

Dependent Variable	Maize Producer Price	Maize Consumer Price
Independent Variables	ADMARC Stocks	ADMARC Stocks
	Maize Market Price	Maize Market Price
	Chicago Corn Price	Chicago Corn Price
	Consumer Price Index	Consumer Price Index
	Cotton Producer Price	Per Capita Monthly Wage
	Groundnut Producer Price	
	ADMARC Ammonium Sulfate Price.	

ADMARC stocks were closing stocks on March 31. Maize market prices were annual averages of those received by petty traders in local markets. Chicago corn prices were expressed in MWK/ton using official MWK/US $

exchange rates. The consumer price index (CPI) reflected low income market baskets in Blantyre. Ammonium sulfate price proxied for cash costs of production. Per capita monthly wages were for formal sector wage earners only. In this preliminary analysis, no accounting was taken of informal sector incomes, profits, or smallholder farm income. Annual averages of variables were utilised from 1970-71 to 1986-87.

The most striking relationship we found was between the CPI on the one hand and maize producer and consumer prices on the other hand. The correlation coefficient (r) between the CPI and each price was about 0.97, suggesting prices predominantly have responded to living costs. As one would expect, the CPI also was highly correlated with all the other Malawi prices and with wages. Consequently, the use of prices in undeflated form results in severe collinearity and obscures underlying relationships. We therefore deflated prices and wages with the CPI in subsequent analysis.

The only factors found significantly to have affected real ADMARC producer prices were domestic maize market prices and Chicago corn prices (R^2 was 0.35). Nonsignificance of cotton and groundnut producer prices was surprising because one would expect the maize producer price to be determined relatively to incentives provided for these other commodities. However, all domestic agricultural prices probably are determined simultaneously so the present single-equation specification is likely an oversimplification. The fertilizer price was nonsignificant, perhaps because the CPI already largely reflects annual changes in farm production costs (i.e., real fertilizer prices have not varied much until very recently). Hence, the hypothesis that producer prices have responded to farm production costs is not contradicted. Nonsignificant effect of ADMARC carryover stocks on producer prices may be the most surprising of all: one would think that when stocks are low, government would offer higher real producer prices (as ADMARC reports claimed happened in the early 1980s). Perhaps government has on average been unwilling to allow reserve stock instability to destabilise producer prices. This would be consistent with objectives (b) and (e), though in some cases it would work against objectives (a), (c) and (d) described on page 109.

Estimated elasticities of producer price with respect to the two statistically significant factors, domestic maize market price and Chicago price, were (at sample means) 0.38 and 0.25, respectively. This means, for example, that a 10.0% increase in the Chicago price has on average resulted in a 2.5% increase in ADMARC producer prices. Thus, maize producer price indeed has been stabilised relative to this particular measure of world price, a result one would expect given Malawi's relative geographic isolation and application of the price stabilisation objective.

Consumer price administration in practice
The only factor that significantly affected real ADMARC consumer prices was ADMARC stocks (R^2 was 0.12). Nonsignificance of real wages probably arises from the chance negative correlation between real wages and stocks. Nonsignificance of domestic maize market and Chicago corn prices may partly arise from colinearity, although we suspect it is owing also to government's strong. emphasis on objective (i)--the consumer price stabilisation objective. ADMARC reserve stock levels do tend to be negatively related to the subsequent year's announced consumer price. Hence there has been some tendency for government to reduce large reserves by offering a consumption incentive or to discourage consumption in order to protect low reserves. But these effects have not been great. A 10.0% stock increase was associated with only a 0.5% reduction in consumer price, the t-value for the relationship being -1.44. The principal thing that can be said, in fact, about ADMARC's consumer maize price is that it has responded positively to living costs. Insensitivity of consumer prices to other supply and demand factors partly accounts for ADMARC's financial difficulties.

There has been no statistically significant autoregressive behaviour in Malawi's real producer or consumer maize prices. Thus, for instance, real maize prices have followed no cyclical pattern of a type that an autoregressive model could uncover. This suggests that when setting prices, the Malawi government at least has been aware of the information content of past real prices. Price instability that would arise from ignorance of this information apparently has been avoided. This does not necessarily imply that ADMARC prices have adequately incorporated nonmaize price information. Indeed, the nonsignificance of numerous nonmaize price variables in the above regressions suggests Malawi maize prices have not embodied all the information that they should have. It remains to be seen whether, given enough time, a liberalised market will perform better than the old controlled one.

MARKET LIBERALISATION IN ZIMBABWE: THE CASE OF SUBSIDIES, 1980-1987

R. Davies[1]

INTRODUCTION

The foundations of the current Zimbabwean economy were, to a great extent, laid in the 15 years following the *Unilateral Declaration of Independence* (1965 to 1980). During this period, there was considerable industrial development and diversification of the economy, both between sectors and within sectors. For example, the virtual monocrop orientation of commercial farming before *UDI* was reduced with the value of tobacco marketed falling from around 70% of marketed crops in 1965 to about 30% in 1980.

These changes took place in an economy with both a high degree of protection through sanctions and a high degree of state intervention and regulation. In many ways, it was a textbook example of the dirigiste economy against which the currently fashionable arguments for liberalization are directed.

Independence brought with it some liberalization. The removal of sanctions is conventionally credited with reducing import prices by 10% and raising export prices by a similar amount. Government also adopted a more relaxed attitude towards the allocation of foreign exchange, mainly under the stimulus of expected capital inflows under the Zimbabwe Conference on Reconstruction and Development. This opening up of the economy would, I presume, be regarded as a good thing by proponents of liberalization.

However, while this was taking place, government also continued, or adopted, policies which ran counter to the liberalization argument. It strengthened the minimum wage system and intervened more directly in the labour market, effectively eliminating collective bargaining. Although interest rates were raised, the inherited financial repression was maintained and controls over financial institutions were tightened. The price control system was maintained and strengthened. After 1982, as the economy moved out of the post-independence boom, government responded by attempting to regulate the economy even more (ie., by progressively increasing controls on the invisible and capital accounts of the balance of payments).

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Thus, it is questionable whether, on balance, there has been any liberalization in Zimbabwe. Currently, there is a growing debate on the issue, most publicly between the pro-liberalization forces of the World Bank and Professor Hawkins[2] on the one hand, and the Confederation of Zimbabwe Industries and part of the government on the other hand. No clear policy has yet emerged from this debate, let alone any concrete actions. Therefore, it is premature to review the liberalization experience of Zimbabwe since 1980, as I was asked to do in this paper.

The only area in which liberalization has occurred is with respect to subsidies. Almost from independence, there has been a widespread belief that government needed to cut the level of budget subsidies. Government has shared this belief and has made some attempts to actually reduce them. Therefore, this paper concentrates solely on the question of subsidies and, more specifically, food subsidies.

REVIEW OF THE SUBSIDY DISCUSSION SINCE INDEPENDENCE

This section argues that since independence a conventional wisdom on food subsidies has emerged. A few key contributions to the debate are reviewed along with how the arguments are reflected in official government statements.

Callear's contribution

The first detailed contribution to the post-independence debate on subsidies was a paper presented by Diana Callear at a conference on rural development, organised by the Zimbabwe Economic Society in May 1981 (Callear, 1981). This paper remains one of the most comprehensive statements, in terms of its attempt both to raise issues and to establish a theoretical framework for discussions.

Apart from her attempt to clarify some of the theory of subsidies, Callear made some specific observations on the operation of the subsidy system in Zimbabwe. Several of her points are reflected in later contributions to the debate and have become part of the conventional wisdom. Her main concern was with the mistargeting of food subsidies. She concluded that "the main beneficiaries of producer subsidies as they stand are the large producers. The main beneficiaries of the various consumer subsidies are not as clearly defin-

[2]Department of Business Studies, University of Zimbabwe.

ed, but they are generally the urban salary and wage earners, who are certainly not the poor" (Callear, 1981; p. 12).

A second concern of Callear's paper was with the negative impact of subsidies on the peasant sector. She argued that the low consumer price of food implied by the subsidies reduces peasants' food production, encourages greater producer sales to the Grain Marketing Board (GMB), and encourages farmers to switch from producing food crops to nonfood crops. She argues that all of these effects reduce rural food security in the long-run, although rural consumers might benefit from the lower prices in the short-run. Finally, although Callear mentioned in passing the implied financial burden of the growing subsidies, she did not examine this aspect in detail.

Therefore, on balance, Callear's analysis was critical of Zimbabwe's blanket subsidy system. She suggested that more selectively-targeted interventions would be more efficient and concluded that the "large savings to the exchequer of abandoning the system could well be used to increase the rate of redistribution through speeding up the land reform programme" (Callear, 1981; p. 15).

The Riddell Commission

It is unclear how much direct impact Callear's paper had. The first widely noticed contribution to the debate was by the Riddell Commission. It's report (June 1981) raised several criticisms of subsidies (Zimbabwe, 1981; pp. 67-69, 190-195). It argued that a low food price policy adversely affects the incomes of food producers and that subsidies on some products can reduce incomes of those producing competing products. It demonstrated that subsidies were badly targeted, using Callear's illustration that an estimated Z$5 million per year was spent to subsidize beef consumption by pets.

The commission emphasized the difficulty of financing subsidies and the growing burden they were placing on the government budget. Finally, they argued that subsidizing maize meal could have negative employment and nutritional consequences, since it favoured modern roller mills against traditional rural millers.

The commission raised only two specific advantages of subsidies. First, it suggested that subsidies might be used to transfer income to food producers by raising producer prices above market-clearing levels, which has food security consequences. Second, it argued that subsidies convert the "residual buying role" of marketing boards into monopsonies. This can be beneficial by providing more stability, except where the boards become excessively bureaucratic.

The commission explicitly recommended that government gradually phase out the blanket subsidies on foodstuffs. It argued that "the most effective, permanent, and least costly method of protecting consumers from rising food prices is to ensure that their incomes are sufficiently high to allow these prices to be paid" (Zimbabwe, 1981; p. 193). This captures the underlying view of the commission, that although subsidies can be used to protect the poor, they are unnecessary where the poor have the power to protect their incomes. (In this case, food subsidies can be an indirect subsidy of wage bill.) The commission observed that food prices in Zimbabwe were among the lowest in Africa and that Zimbabweans must realize that these low prices are unsustainable in the long-run.

The Chavunduka Commission

The Riddell Commission's criticisms of subsidies were echoed by the 1982 Chavunduka Commission (Zimbabwe, 1982a; pp. 137-139). It argued that the financial burdens imposed by high subsidies inevitably led to massive, disruptive, and often uncontrolled price increases; that producer prices are set at unrealistically low levels in order to relieve this financial burden, leading to food shortages and balance of payments problems; and that subsidies favour urban consumers and provide little benefit to the vast majority of rural dwellers who produce their own food. Therefore, they recommended that government phase out consumer subsidies on agricultural products as rapidly as possible.

The main difference between the two commissions was that the Chavunduka Commission recommended replacing blanket subsidies, where necessary, with more carefully targeted welfare measures; while the Riddell Commission recommended not only such measures, but also additional measures to raise incomes to allow consumers to pay the higher prices.

The Jansen report

In a paper written for USAID, Doris Jansen presented a more extended technical analysis of agricultural prices and subsidies in Zimbabwe (Jansen, 1982). She compared domestic and border prices for Zimbabwe's major agricultural products to determine the extent of implicit subsidies and taxes for both consumers and producers.

Jansen found that groundnuts were the only crop where producers had been and were currently taxed[3] (i.e., producers were paid considerably below the border price). She pointed out that this was the major strength of pricing policy in Zimbabwe, avoiding problems that had arisen elsewhere in Africa. However, in her view, it also reflected a serious shortcoming, in that prices were to too great an extent based upon considerations of com-

[3]I believe that these findings were broadly substantiated in a later paper by Thomson, although I have not examined that paper (Thompson, 1985).

mercial farmers' costs of production. Thus, she recommended switching to using border prices as a basis for price setting (Jansen, 1982; p. 24).

As far as consumer subsidies were concerned, Jansen argues that a major change was required immediately. The high subsidies imposed an unbearable strain on the government's budget; they led to artificially high demands for the subsidised products which rendered food self-sufficiency a constantly receding target; and the subsidies widened the real income gap between urban and rural dwellers.

These papers and reports raise similar themes and were all critical of the blanket subsidy system in Zimbabwe. Their main criticisms were that the subsidies imposed too great a burden on the exchequer; that the system was, at best, badly targeted and inequitable; and that they probably had a negative impact on peasant households or on food security in the communal areas.

Official government statements

The conventional wisdom against subsidies summarized above has been accepted by government, as reflected in a number of official documents and statements.

The *Three-Year Transitional National Development Plan* noted that although pricing policies had enabled Zimbabwe to attain food self-sufficiency and to keep food prices low (especially for urban consumers), these achievements had considerable costs. These included "the relative neglect of the communal areas, the inequity of the food subsidy policy, some economic inefficiency arising from the fact that pricing policy was primarily determined on the basis of commercial farmers' production costs, and a heavy burden on the Treasury from what is evidently an inequitable food subsidy policy" (Zimbabwe, 1982b; p. 68).

In his 1984 budget speech, Dr. Chidzero emphasised the strain subsidies were imposing on the budget, although his remarks appear aimed more explicitly at nonfood subsidies (Zimbabwe, 1984; pp. 30-33). In 1985 he argued that the reduction/removal of subsidies on certain foodstuffs had been necessary because of "the implications on the size of the budget, and the fact that subsidies do not necessarily benefit those who most need assistance. An additional factor contributing to increases in food prices has been the need to encourage food self-sufficiency, through increased production" (Zimbabwe, 1985; p. 8).

BACKGROUND TO SUBSIDIES AND PRICE CONTROLS IN POST-INDEPENDENCE ZIMBABWE

Before evaluating the conventional wisdom identified in the previous section, it is useful to provide some background to subsidies in post-independent Zimbabwe.

The structure of subsidies

Table 1[4] provides the budgetary setting for subsidies since independence and shows that although food subsidies are significant, they are not the major portion of the subsidy/transfer budget. While subsidies to parastatals such as the Zimbabwe Iron and Steel Company, National Railways of Zimbabwe, and Air Zimbabwe have all been significant; grants by the Ministry of Education to private schools probably constitutes the biggest single transfer. Interest payments have also been growing rapidly.

Turning more specifically to food subsidies, the first point to emphasise is that we are considering such subsidies within a general system of price controls. The subsidies are paid on administered prices, not market determined ones. Apart from general price controls which include the current price freeze, there are specific controls relating to food and food producers. Government sets both the producer and the consumer prices of controlled products, which include most basic foodstuffs. In addition, government sets the prices of some inputs such as fertilizer, electricity, coal, and railway transport. In practice, the price controls on food are probably the most effective of the whole price control system.

The main agricultural products subject to price control are maize, sorghum, groundnuts, soyabeans, wheat, and coffee which are all traded by the Grain Marketing Board; cotton, traded by the Cotton Marketing Board; beef and sheep, traded by the Cold Storage Commission; and milk and diary products, traded by the Diary Marketing Board. Both producer and wholesale prices for these products are set by the government through the Agricultural Marketing Authority (AMA). Where the wholesale price is set in relation to

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[4]In constructing this table, repayment of borrowings were offset against new borrowings, so the totals do not correspond with those in published government sources. Because this reduces overall disbursements, it makes the shares of components higher than they might otherwise be. Nevertheless, it is a reasonable way to present government finances.

Table 1. Food subsidies in relation to other components of central government budget, Zimbabwe.

Item	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88
Millions of Z$ (Nominal Terms)								
Goods and Services	598.6	763.3	910.1	1053.1	1111.8	1346.1	1674.7	2278.5
Total transfers	538.5	685.7	909.9	1770.2	1326.3	1559.2	1877.3	1588.4
Food subsidies	68.7	122.1	126.5	64.5	149.7	155.0	168.5	210.1
Other subsidies	297.4	346.6	507.6	760.5	739.3	880.8	1080.9	612.3
Other transfers	172.4	217.0	275.8	345.2	437.3	523.4	627.9	766.0
Other expenditure	144.6	231.9	426.4	394.5	481.7	389.8	501.3	748.7
DISBURSEMENTS (TOTAL)	1281.7	1680.9	2246.4	2617.8	2919.8	3295.1	4053.3	4615.6
Revenue	1000.2	1359.1	1765.0	1943.6	2131.7	2519.3	2953.9	3478.0
Deficit	-281.5	-321.8	-481.4	-674.2	-788.1	-775.8	-1099.4	-1145.6
Aid net borrowing	0.0	5.4	24.2	56.9	81.1	99.5	102.5	158.0
RECEIPTS (TOTAL)	1281.7	1680.9	2246.4	2617.8	2919.8	3295.1	4053.3	4615.6
Percentage of Total Disbursements								
Goods and services	46.7	45.4	40.5	40.2	38.1	40.9	41.3	49.4
Total transfers	42.0	40.8	40.5	44.7	45.4	47.3	46.3	34.4
Food subsidies	5.4	7.3	5.6	2.5	5.1	4.7	4.2	4.6
Other subsidies	23.2	20.6	22.6	29.1	25.3	26.7	26.7	13.3
Other transfers	13.5	12.9	12.3	13.2	15.0	15.9	15.5	16.6
Other Expenditure	11.3	13.8	19.0	15.1	16.5	11.8	12.4	16.2
DISBURSEMENTS (TOTAL)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	.100.0
Revenue	78.0	80.9	78.6	74.2	73.0	76.5	72.9	75.2
Deficit	-22.0	-19.1	-21.4	-25.8	-27.0	-23.5	-27.1	-24.8
Aid	0.0	0.3	1.1	2.2	2.8	3.0	2.5	3.4
Net borrowing	22.0	18.8	20.4	23.6	24.2	20.5	24.6	21.4
RECEIPTS (TOTAL)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ratio to GDP (Market Prices) of (%):								
Food subsidies	1.86	2.64	2.34	1.03	2.12	1.85	1.78	2.02
Budget deficit	7.63	6.97	8.91	10.75	11.18	9.25	11.61	11.00
Gross borrowings	12.17	11.18	14.54	13.84	14.23	11.92	16.40	14.37

Source: Zimbabwe, (various dates a, b)

the producer price so the responsible authority is unable to cover its costs, the losses are paid out of the central government budget. These subsidies have risen considerably over the years. There were also subsidies paid by government to private food processors which are related to maize meal, flour, edible oils and opaque beer.

Table 2, which summarises the allocation of food subsidies since independence, shows that the subsidies to private firms have been phased out. However, those to marketing boards have continued and have grown in nominal terms, despite some fluctuations.

Several features of the subsidy system need to be highlighted.

- o It is difficult to calculate the precise quantitative impact of subsidies on consumers because of the way they operate. Producer and consumer prices are set and the relevant marketing board incurs losses. The precise loss is only known some years later after auditing. Thus, the subsidy appearing in the annual budget actually covers losses incurred some years earlier. For example, the Z$2.5 million maize meal subsidy in 1986-87 actually related to outstanding losses from previous years.
- o Because prices are set at the start of the agricultural season, it is impossible to know precisely how much the subsidy will be. Indeed, because losses are only reflected in the budget several years later, it is impossible to know what level of subsidy was required--until some years after the season concerned.
- o The system is likely to be pro-cyclical. The better the season, the higher the marketing board's losses. Therefore, the AMA will have to borrow more in the money market to finance its operating costs, which should push up aggregate monetary demand in years in which it is already high. In bad seasons, the opposite is true.
- o Because of the lag between when the loss is incurred and it entering the central budget, there is no obvious connection between the state of the economy and the impact of subsidies on aggregate demand.

Impact of subsidy reduction on consumer prices

Attempts to reduce subsidies have been accompanied by sharp increases in administered consumer prices. For example, the price of roller meal was raised by 50% in 1982 and a further 40-45% in 1983. Beef prices were raised by 30% in 1982 and up to 55% in 1983. The same pattern of relatively sudden increases applies across the board to the controlled products. In fact, this was one of the grounds on which the Chavunduka Report criticised subsidies--that they would lead to periods of stagnant prices followed by sudden and sharp increases as the financial burden became too great. While all of the critics argued that government should phase out subsidies in an orderly manner to avoid sudden price hikes, this advice does not seem to have been

Table 2. Food subsidies in Zimbabwe, 1980-81 to 1987-88 (Z$ million)

Item	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88
To marketing boards:								
Beef	9,619	25,730	33,289	36,518	41,630	39,283}	}	
Dairy	4,110	10,354	18,329}		31,682	39,329}	}	
Maize	9,662	5,110	22,910}	86,000[a]	36,719	43,731}	166,000[a]}	210,101[a]
Soya	1,919	956	0 }		4,608	1,608}	}	
Wheat	0	0	0	0	11,638	9,173}	}	
Sorghum	0	0	0	0	1,400	581}	}	
Total	25,310	42,150	74,528	122,518	127,676	133,715	166,000	
To private firms:								
Bakers flour	6,663	8,500	1,939	0	0	0	0	0
Edible oils	5,700	6,200	0	0	0	0	0	0
Maize Meal	20,150	64,800	49,186	28,000	22,000	15,000	2,500	0
Opaque beer	1,048	400	0	0	0	0	0	0
Total	33,567	79,900	51,125	28,000	22,000	15,000	2,500	0
Total food subsidies:	58,875	112,050	125,653	150,518	149,676	148,715	168,500	210,101

[a]Data not available by category. This value is the total for categories to the left of the numbers.

Source: Zimbabwe (various dates, b)

followed. Thus, in September 1983 when the first major round of subsidy removals was made, the food price index for low income families rose by 26.9% over its August level.

Producer or consumer subsidies

The final general issue is the extent to which the subsidies are producer or consumer subsidies. Callear, Jansen and Thomson (Callear, 1981; Jansen, 1982; Thomson, 1985) have addressed this topic, so I will only highlight the theoretical issues.

The question of who is being subsidised hinges on what the price of the product would be in the absence of the subsidy. In a free market system, the reference price would be the market clearing price. We would normally expect the subsidy to be shared between producers and consumers, unless supply or demand is perfectly inelastic. This sharing is independent of to whom the financial subsidy is paid to in the first instance.

Because we do not have a free market, the normal choice is to take the border price as the reference price, arguing that the border price reflects the opportunity cost of the product concerned. Because of the assumption of perfectly elastic world demand and supply, this procedure ends up with the entire (implicit) subsidy going to either consumers (controlled price below border price) or producers (controlled price above border price)--unless there are separate producer and consumer prices.

Border prices are widely used as reference prices. However, we should note the following. First, at a theoretical level there is reason to question the extent to which policy makers should take border prices as shadow prices. In theory, shadow prices are the dual of the objective function from which a constrained optimum allocation of resources can be derived. It is not intuitively obvious that a national objective function would give rise to a set of shadow prices that coincides with the set of border prices--particularly if that objective function includes a distributive component and we do not assume that perfect redistribution is possible. Of course, this argument applies equally to the use of some notional market clearing price as a reference price.

Second, if all price controls were removed so that the market became a free market, the market clearing price would not be the current border price. At the very least, we have to calculate what changes in the exchange rate that complete liberalization would imply.

Third, at a practical level, it is problematic whether we use import parity or export parity prices as the border price. Although a rule of thumb is used--it depends whether the good is imported or exported--I am not sure that it is quite so clear cut.

Thus, there is always some basis to criticise empirical attempts to measure implicit subsidies. As reported above, Jansen and, I believe, Thomson calculated that producers are generally paid above the appropriate border price; so it could be argued that they are subsidised. I am not sure how far the Commercial Farmers' Union would agree.

An interesting avenue for some further work arises from the fact that a subsidy to producers operates rather like a devaluation. Because of the subsidy, the domestic producer price can be that much higher than foreign competitors, before they are unable to compete. A devaluation has the same effect. Calculating the equivalent devaluation needed to give the producers the equivalent level of protection that they currently get through the subsidies might provide further insight into the requirements of a liberalization process.

OBSERVATIONS ON THE SUBSIDY DEBATE

Since there are some recurring themes in the criticisms of subsidies, we can speak of a conventional wisdom on the subject. The main components of this conventional wisdom are that the economy, and more precisely the budget, cannot sustain the burden which subsidies are placing on them (the macroeconomic/fiscal critique); and that subsidies are inefficiently targeted, are inequitable, and may even harm the rural poor (the mistargeting critique). The rest of this paper is structured around these two main issues. To provide a more specific focus, I will keep in mind the question of food security and subsidies, although sometimes my argument will be more general. Before looking at each of these critiques, I wish to make some general points concerning the approach to food security.

Appropriate food security concerns

As an outside observer of the food security debate, it appears that the concerns of the experts have broadened. Initially, the concern was at a relatively aggregate level, with a tendency to regard food security as a national question--does the country produce a surplus or not? More recently researchers have recognized that a national surplus is not a sufficient condition to ensure that people do not starve. The currently accepted definition of food security seems to be "access by all people at all times to enough food for an active, healthy life" (World Bank, 1986; p. 1). This places emphasis not only on the household level, but also on income distributional--rather than simply income generational-issues. Thus, research interests have shifted away from national issues towards household and intra-household questions.

This trend is correct. Indeed, I expect and wish it to go further to consider some of the intrahousehold issues being raised in the literature on women in development. But we clearly need to be careful not to throw out the baby with the bath water. National issues are important. I am not thinking simply of questions such as storage, transport, and other infrastructural issues which are still being examined; but the whole range of macroeconomic issues, stabilisation, and trade policies etc. which impact on the level and distribution of incomes. Macroeconomic management of the economy can have as great an impact on incomes and income distribution as, for example, drought and rain.

Clearly subsidies impact on food security through both their microeconomic impact on resource allocation and their macroeconomic impact through the budget and balance of payments. Therefore, we need to locate the households we are studying in the overall economic framework.

Second, there appears *de facto* to be a tendency to regard food security issues as primarily the concern of agricultural economists. When someone says they are conducting research on food security, one immediately has a picture of them working on something to do with peasant households, or at least in rural areas. Of course, this is not a universal tendency. We do find literature reference to the urban unemployed or the urban informal sector, but these groups are not a major focus of food security researchers.

Discussions of food security must include urban workers for several reasons. First, although there is a tendency to dismiss them as being among an elite who have no problems of poverty, this is not true. Second, there are important linkages between the sectors, with members of the same household operating in both. Since policies which directly impact on urban workers indirectly impact on rural households as well, there needs to be a component of food security research which looks specifically at urban households.

To properly examine these issues, one must use a relatively formal model of household behaviour, distinguishing between different categories of household and locating them within the broader framework of the economy. Some of the data needed for such an exercise can be drawn from the household survey work being done by the Central Statistics Office, the Zimbabwe Institute of Development Studies, and individual researchers such as Jeremy Jackson and Jayne Stanning. With the decision by the Central Statistics Office to build a social accounting matrix for Zimbabwe, we hope to obtain some of the data needed to put these micro surveys into an internally consistent picture of the economy. However we will still need a lot of work and debate to formulate appropriate models for the data.

Since we do not yet have this analytical apparatus, most of what I wish to do is very speculative and based on prejudged speculations about what I think the data shows. However, I hope it may stimulate some ideas, even if only because I am wrong. Let me now consider each of the two conventional critiques I referred to above.

The macroeconomic/fiscal critique

Formerly, students of macroeconomics were told that subsidies were a form of transfer payments. Therefore, they had no macroeconomic consequences, unless there were differences in the marginal propensities to consume of the groups between whom the transfer was being effected. In that case, a transfer from rich-to-poor would raise the consumption level and reduce the savings level for any given level of national income. But in the absence of such differences, this old (Keynesian) approach simply tells us to net transfers out of the public accounts and ignore them.

A more sophisticated Keynesian approach acknowledges tax revenue constraints and point to the opportunity costs operating between different items on the expenditure side of the budget. This, for example, underlies the critique raised by Callear when she argued that the subsidy programme diverted money away from the resettlement programme which would have more directly treated the problem of rural poverty. While this is analytically correct, we need to use a political economy approach to government expenditures to understand whether or not it is applicable to Zimbabwe. Using the hindsight that was denied to Callear, there are some grounds for questioning whether any monies saved from subsidy removal would have been channelled into a more vigorous land resettlement programme. As with all alternative proposals, we must be satisfied not only that they are theoretically preferable; but also that they are likely to be introduced, given the political and economic realities. I think that this runs through the whole debate. It could be argued that government has accepted the advice to cut subsidies without adequately implementing alternatives that have been put forward.

The more modern macroeconomic critique of subsidies focuses on their monetary consequences. They are seen as contributing to the deficit and thus to government borrowing and monetary expansion. More precisely, this approach does not distinguish between categories of government outlay, as far as their consequences on the deficit are concerned.

Since this is not a paper on monetary theory, let us accept that government deficits do increase the money supply. The importance of food subsidies is then an empirical question. How important in fact are food subsidies in contributing to the government's deficit in Zimbabwe? Table 1 shows that in the post-independence period, food subsidies amounted to between 2.5% and 7.3% of expenditure. (We could make this figure lower by not netting out repayment of borrowings). Over the whole period, they averaged to 4.8%.

Assuming tax revenues remained the same after withdrawing the food subsidies, then the deficit would have fallen by the amount of the food subsidy. This would have reduced the deficit in 1981-82 by 37.9% and in other years by a smaller proportion. But can we assume that the tax revenue would remain constant? *A priori*, there are a number of factors which would cause it to change. Although a general equilibrium model is needed to assess the net effect of these factors, intuition tells us that tax revenues would decline. First, there is the general deflationary effect of the deficit reduction. Second, if removing the subsidy reduces producer prices of the subsidised products, it would also reduce producer's incomes and taxes. Third, if consumer prices rose, consumers would shift expenditures away from other commodities (in so far as the subsidised products are basic and have a relatively inelastic demand) which would reduce sales tax revenues. Thus, it is likely that since removing food subsidies would lead to a fall in revenue, it would reduce the deficit less than the amount by which food subsidies were reduced.

Even if removing the food subsidies cut the deficit by somewhat less than 20%, in Zimbabwe's current economic situation this would still be significant. However, food subsidies are not the largest form of subsidy in Zimbabwe. To some extent, the question of food subsidies is coloured by the overall level of subsidies in the budget. The general and obvious point is that reducing the former should be viewed in the context of a programme to reduce the latter. It government is to reduce its deficit by reducing subsidies, there are other subsidies which should probably be higher priority candidates for cuts.

At a less aggregated level, there are the whole set of arguments very much related to the liberalization debate which concentrates on the "distortions" created by subsidies; particularly the effect they have on the production and consumption of tradables.

We saw above that the redistribution resulting from removing the food subsidies would result in higher consumption and reduced savings. Thus, it would affect the resource balance, accumulation, and future economic growth. But this is surely the consequence of any redistributive programme; one might even say, the intended consequence. To present this as a criticism of subsidies is, in essence, to question the desirability of a significant change in Zimbabwe's inherited income distribution.

A related point is most clearly articulated by Jansen, who argued that consumer subsidies were "leading to artificially high demands for the subsidized products" (Jansen, 1982, p. 27). I think this is correct, but have some difficulty in seeing it as a criticism of subsidies. The point of the subsidies is fundamentally a redistributive one. They are intended to raise the real income of the poor. Therefore, we would expect increased consumption of the subsidised products. In countries where most food is imported, there may be balance of payments consequences of subsidising food imports, but this does not apply to Zimbabwe.

The mistargeting critique

One of the main thrusts of the critics of subsidies in Zimbabwe is that they are inequitable. This centres around the evidence that, in some cases, more of the subsidies go to high income families. In other words, the subsidies are badly targeted. This argument is reflected in official statements on the issue.

Even accepting the evidence at face value, this argument is badly constructed. Badly targeted subsidies are not necessarily inequitable. They reduce the progressivity of the fiscal system, making the redistribution of income less than it would appear from an examination of the tax system alone. But this is not the same as increasing inequality since the distribution of income is likely to be better with the tax/expenditure system than without it.

In any event, considering the relative impact of the subsidies on the real incomes of the rich and the poor, even a badly targeted subsidy will raise the real income of the poor more than it raises that of the rich.

What can be argued, and generally is by the critics, is that a badly targeted subsidy is inefficient. This underlies the critique of blanket subsidies and the call for a more selectively targeted system. However, as economists we should not accept at face value the view that a selectively targeted system is more efficient than a blanket one. We should look at he costs of administering the two alternatives. In a sense, that portion of the blanket subsidies which does not hit the target can be regarded as part of the cost. Given that even selectively targeted subsidies will have some leakage, that their administrative costs are likely to be considerably higher than a blanket system such as Zimbabwe's, and that there is probably much more scope for abuse; should we accept a *prima facie* case in favour of selectively targeted subsidies?

To this general argument we should add some technical issues. To my knowledge, none of the critics of blanket subsidies have presented details on what specific selectively targeted subsidies they feel could work in Zimbabwe. We should carefully consider the assumption of separable markets which underlies the case for selective targeting. While there are examples of selectively targeted subsidies in other countries, the successful ones are generally aimed at important, but relatively narrow groups--such as households with malnourished children under five or with lactating mothers rather than with the poor in general. This evidence does not contradict the argument that blanket subsidies might be the most efficient way of reaching a wide stratum of the poor.

In Zimbabwe, the Child Supplementary Feeding Schemes are a selectively targeted subsidy. Since some reports suggest childrens' meals at home have been reduced once they received meals at school, the schemes may not improve their overall diet. This example shows the importance of taking into account fungibility and substitution when targeting subsidies. In practice, the selected target may not be the one that is hit.

The position taken by the Riddell Commission, but not picked up by other critics of subsidies, was that government should remove subsidies in conjunction with policies designed to increase the incomes of the poor. In particular, they recommend providing immediate access to better land for the rural poor and a phased introduction of poverty datum line based minimum wages for the working poor. In fact, it appears they saw these measures as required prior to any reduction of subsidies.

Mistargeting and inequity issues are most commonly raised in Zimbabwe with respect to urban and rural populations. It is commonly accepted that the bulk of the poor live in the rural areas, while the bulk of the subsidies go to urban consumers. Again, this conventional wisdom needs to be carefully examined. The analysis of microeconomic household survey data being collected by a growing number of researchers can make an important contribution to testing this supposition. In the absence of clear rural household models, let me continue to make some speculative observations.

First, consider the question of remittances. We know that remittances are received by over 30% of communal households; that for these households remittances constitute an important source of income; and that there is evidence that child nutrition is higher in rural households receiving remittances than in those that are not. How do subsidies affect remittances? Unless remittances are seen by the remitting households as inferior goods, we would expect them to be positively related to subsidies. Conversely, removing subsidies will reduce the real income of urban members of households and, *ceteris paribus*, reduce remittances. Second, remittances are often in-kind rather than cash. There is evidence that during the drought, subsidised maize meal flowed to the rural areas. Thus, the final consumer (the recipient of the subsidy) may not be the initial purchaser. The fall in real income for urban dwellers, consequent upon subsidy removal, will reduce flows of other goods--particularly productive inputs and small capital items. It is clear the remittances are one channel through which the removal of subsidies can have a negative impact on production, consumption, and accumulation in communal lands. Thus, any household modeling undertaken has to reflect a clear understanding of the nature and role of remittances.

Second, consider the more direct impact of subsidy removal on communal households. The critics of subsidies have argued that subsidies are likely to have a negative impact on these households. Let us further analyse this argument. In the first place, we have to differentiate between households, as some of the critics do. The fundamental dichotomy is between those households which are net consumers of subsidised food and those which are net producers. As argued elsewhere (Davies and Sanders, 1987), the rise in prices following attempts to reduce subsidies reduced real incomes of net consumers and raised those of net producers. Furthermore, we argued that there are signs that the proportion of net consuming households is growing,

A more thorough analysis would make finer distinctions than this simple dichotomy. Among producers, it would be useful to distinguish between those that produce the controlled good and receive the controlled price (i.e., most commercial farmers); those that produce the controlled good, but do not receive the controlled price (i.e., peasants who do not sell to the marketing boards); and those that do not produce the controlled good.

For producers in the first category, the crucial issue is the extent to which the controlled price is above or below the price they would otherwise obtain. As argued previously, the answer is not immediately obvious and requires further work.

The conventional wisdom accepts that subsidies reduce the prices received by producers in the second category, since the effective price for them is that which the consumers pay. While this seems probable, it is not certain. For example we can adapt an argument from the analysis of buffer stocks, that suggests that those outside the system might receive higher prices. Crudely, assume that the consumers have $100 to spend on buying 100 units at $1 each. The controlled price of $0.50 covers one-half the supply. Consumers have satisfied one-half of their demand for only $25. They might be willing to pay a higher price to obtain the remainder. If they paid $1.50 each, they would spend $75 to get the remaining 50 units, and would have spent $100 overall. Obviously, substitution and elasticities affect the numerical outcome, but the net effect could be the same. Those outside the controlled market receive a higher price than those inside it; and depending on the actual numbers, possibly even higher than the market price.

The argument underlying the conventional wisdom goes as follows. The market is for a homogeneous product. Therefore, as far as consumers are concerned, controlled output and uncontrolled output are perfect substitutes. According to basic demand theory, reducing the price of a substitute leads to a fall in the price of the product. Therefore, if the price controls reduce the price of the output from the marketing boards, they should reduce the price in the informal peasant market. However, the alternative argument is that controlling the price of marketing board output creates excess demand and therefore increases the demand for and the price of the uncontrolled output.

Subsidies should have an income effect on the demand for the output of producers in the third category. How this will work depends upon the change in relative real incomes that takes place and what commodity the particular producer sells. It is possible that informal sector producers who produce wage goods will find that demand for their product rises, while producers who produce luxury good will find that their demand falls.

CONCLUSION

This paper raises question about the conventional wisdom regarding subsidies in Zimbabwe, by showing that there are several questions that can still be asked, or need still to be answered. In essence, while there are valid criticism of blanket subsidies, it is wrong to make a blanket dismissal of them.

In the debates over market liberalization, my concern over the rejection of subsidies is a specific instance of a wider concern I have with liberalization policies. The case against subsidies fundamentally rests on a view that in a free market (or in the absence of a free market, free trade) the allocation of resources is optimal. This of course is the basis for all liberalization arguments. Numerous theoretical and practical objections have been raised against this view in the history of economic thought. Currently, we appear to be going through period in which free market views are dominant, but the pendulum will swing back.

The case for liberalization fundamentally assumes that it is possible to redistribute income in any way we wish, so that the income distribution arising from a specific system of production is irrelevant in judging that system. Thus, we can concentrate on efficiency, comparative advantage, border prices, etc. and ignore any distributional consequences. If we accept this premise, then we also have to accept that governments are expected to redistribute income and that a tax/subsidy system is a legitimate and standard way of doing so. In this case, the debate should now concentrate much more specifically and practically on improving the redistributive mechanisms in Zimbabwe.

However, if we believe, as I do, that production and distribution are not separable and that there are practical limits to feasible redistribution; then the primary distribution of income is an important aspect of any system of production. In this case, although subsidies and other redistributive mechanisms might have a short-run welfare impact, their impact on asset ownership and patterns of accumulation is of greater concern. Perhaps this is the line along which further work should be undertaken.

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MARKET LIBERALIZATION AND FOOD SECURITY IN MALI

J. Dione and J. Staatz [1]

INTRODUCTION

Since 1981 Mali has been fundamentally restructuring its economy, aimed at placing greater reliance on the market as a coordinating mechanism, redefining the state's role in the economy, and stabilising macroeconomic variables such as the balance of payments, the government budget, the rate of inflation, and the growth of national income. This structural adjustment process has involved a broad range of activities, including rewriting of the commercial and fiscal codes. The centerpiece of the reforms has been the liberalization of the cereal markets, under the multi-donor financed Cereal Market Restructuring Project, known by its French acronym, PRMC.

This paper describes the background and goals of the PRMC, evaluates its performance during its first six years, discuss the role of food security research in informing the reform process, and draws implications from the Malian experience for the design of market liberalization and related policy research elsewhere in Africa.

BACKGROUND TO THE PRMC

A short history of agricultural policy in Mali

Mali is among the poorest countries in the world, with a 1985 per capita GNP estimated at US$150 (World Bank, 1987, p. 202). The physical resource base is perhaps the most diverse of any Sahelian country, ranging from the Sahara desert in the north (which covers approximately 65% of the country's total area) to Sudano-Guinean areas in the south receiving over 1,400 mm of rainfall per year. Dryland agriculture and livestock raising employ the bulk of the population. Irrigated farming, flood-recession agriculture, and fishing are important along the country's three major rivers--the Niger, the Bani, and the Senegal.

Approximately 70% of total calories in the Malian diet come from cereals, with millet, maize and sorghum accounting for about 85% of the cereal cal-

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ories. Rice, of which approximately 50% is imported, is produced mainly in government-organized perimeters such as the Office du Niger, and is widely-consumed in urban areas. Cotton (grown in the south) and livestock are the two most important foreign exchange sources. Although in recent years the Malian government and donors have given priority to university training in agriculture and social sciences, trained personnel are extremely scarce, and the quality of statistical data on the rural economy is limited.

The French colonial strategy called for Mali, with its low population density and irrigation potential, to become the breadbasket of French West Africa. Until the mid-1960s Mali was a food exporter, but since that time bad weather and bad policy have slowed agricultural growth. Throughout the 1970s Mali became increasingly dependent on food imports, particularly food aid (MSU-CESA Working Paper, 86-04).

At independence in 1960, Mali opted for a radical socialist development path, aimed at achieving rapid economic transformation through extracting the economic surplus from agriculture for investment in other sectors.[2] The Modibo Keita government (1960 to 1968) adopted central planning and set up a plethora of state enterprises, including state farms, producer cooperatives, and state trading organizations. In 1964 the state created an official grain marketing agency, the Office Malien des Produits Agricoles (OPAM), to replace a similar colonial entity set up in 1958, and granted OPAM a legal monopoly on the grain trade. OPAM sold grain through consumer cooperatives, mainly to government employees. Roadblocks were established to limit illegal grain movement.

The state fixed official consumer and producer prices for cereals, with the stated aim of achieving three seemingly incompatible objectives: increasing rural incomes, providing cheap cereals to the urban areas, and extracting a surplus from agriculture to finance state investment in other sectors. These objectives could be achieved simultaneously only if productivity grew rapidly in the cereal subsector, but lacking basic investment in research and rural infrastructure, no productivity gains were forthcoming. In practice, the goals of providing cheap grain to the cities and extracting a surplus from agriculture dominated, and official producer prices were held low. Because farmers were unwilling to voluntarily sell sufficient grain to the state at these prices, OPAM resorted to forced deliveries and to financing the subsidized consumer price through accumulated deficits.

A military coup in 1968 brought the present government to power. The new leaders abandoned some of the more radical economic initiatives and in

[2]This paragraph draws heavily on Humphreys, 1986, pp 1-2.

early 1969 abolished OPAM's official monopoly. However, the experiment with liberalization was shortlived, as OPAM accused the private merchants with whom it had contracted for grain of failing to honor their agreements. By the end of 1969, the government reinstated OPAM's legal monopoly, which remained in effect until the PRMC got under way in 1982. In addition, during and shortly after the drought of the late 1960s and early 1970s the government set up, often with strong donor support, numerous integrated rural development organizations. These "Operations de Developpement Rural" (ODRs) and "Actions," were responsible for regional development operations and these ODRs often acted as cereal marketing agents of OPAM.

Even during the Modibo Keita regime, OPAM's monopoly was more fictional than real. Although private trade was repressed, it continued to operate, and OPAM handled only 20-40% of total grain marketings (Humphreys, 1986, p. 5). Since merely 15% of total production was marketed, only about 3-6% of total production moved through OPAM at official prices. OPAM's share of rice marketings was much higher than its share of coarse grains (millet, maize, and sorghum), as rice was produced largely in irrigation perimeters controlled by the ODRs. The repression of private trade, while not enough to eliminate it, undoubtedly increased transaction costs. Although private trade in cereals remained illegal under the new regime (except for the brief experiment with liberalization in 1969), private trade was tolerated, but the degree of toleration varied depended on market conditions. With the 1971 to 1973 drought, OPAM also became the main distribution channel for food aid in Mali, a role which it has retained.

Pressure for cereal market liberalization

During the drought years of the early 1970s, Mali imported large amounts of grain on both commercial and concessional terms. OPAM was obliged to sell the commercial imports at the low official consumer price, which led to an increasing budget deficit. To stimulate production after the drought, the government raised official producer prices, but without a proportional increase in consumer prices, and forced OPAM to finance the implicit consumer subsidies. As a result of these actions and OPAM's weak financial management, OPAM's cumulative budget deficit reached CFAF 20 billion (US$80 million) by 1976-77, equivalent to three times its annual grain sales (Humphreys, 1986, p. 7).

Donor pressure for cereal market reform built during the late 1970s. Donors were increasingly reluctant to finance OPAM's accumulating deficits due to concerns about OPAM mismanagement (the U.S. cut off food aid to Mali for three years because OPAM was unable to account for previous aid) and the perception that OPAM's official monopoly and the system of official prices acted as major disincentives to domestic grain producers. In 1978, FAO and the major donors commissioned a study (the de Meel report), the conclusions of which reinforced the donors' concerns and called for a major overhaul of grain-marketing policy in Mali. In response to the de Meel report, the government agreed, in March 1981, to a reform program that aimed at increasing official producer and consumer prices; liberalizing grain trade to include private traders; and improving OPAM's operating efficiency.

The reforms that became embodied in the PRMC were based on the idea of using food aid to finance market reform. In exchange for a series of promised reforms, 10 major donors[3] pledged multi-year shipments of program food aid. This food aid was sold, with the reflow money going into a common fund controlled by the donors. These funds were to be used to finance specific market-restructuring actions agreed to both by the donors (who first had to agree unanimously among themselves on a course of action) and the government. Donor proposals were initially developed by a donor technical committee, debated among the various donors at the political level, and then proposed to the Malian government.

Basic assumptions of the reforms

The PRMC was launched with several preconceptions on the part of both the donors and the government about how the cereal subsector functioned, but with very little empirical information on the structure of production and marketing. For example, in 1981 the only time series on market prices of cereals (as opposed to official prices) that existed was for retail prices in Bamako. Lacking any farm- or rural-market-level price series, it was impossible to have baseline figures against which to measure the impact of liberalization. Furthermore, the initial design of the PRMC made little provision for strengthening the capacity of the government to monitor the impact of the reforms at the farm level, although it did set up a program of monitoring retail prices in the regional capitals.

Five basic assumptions undergirded the initial phase of the PRMC:

- Official producer prices matter. The PRMC program assumed that by raising official producer prices, farm-level incentives to produce cereals would increase. This in turn assumed that official prices were closely related to the prices farmers actually received for their cereals

[3]The World Food Programme (which acted as the project secretariat), Belgium, Canada, the European Community, France, Great Britain, the Netherlands, the United States, West Germany, and Austria.

(which was true for rice produced in large irrigation perimeters, but much less true for coarse grains), and that farmers made their cereal production decisions primarily based on commercial considerations. It also assumed that if farm prices increased, farmers had the capacity and were willing to expand production in response to those prices.

- All farmers are net sellers. The PRMC called for higher producer prices to not only increase production but also to raise rural incomes, as the donors argued that previous price policy had taxed rural producers to the benefit of urban consumers. Higher grain prices were seen as uniformly helping all farmers, since all farmers were assumed to be net sellers of cereals.
- Private traders would quickly seize the opportunities opened up by liberalization. The designers of the PRMC implicitly assumed that the major constraint facing private grain traders was the anti-merchant policies of the state. Once these were lifted, private traders would rush in to fill the vacuum left by OPAM's relinquishing of its official monopoly. This assumed that traders would immediately accept the reforms at face value and, hence, rapidly invest in expanding their operations. It also assumed that traders faced few other constraints in expanding their operations, such as a lack of working capital.
- OPAM should continue to exist. At no time did anyone seriously suggest abolishing OPAM. The desire to maintain OPAM reflected both the donors' need to have a Malian government institution through which they could channel food aid and recognition of the political necessity of protecting certain of OPAM's privileged clientele, such as the army, from higher grain prices. These factors explain the apparent paradox that most of the actions undertaken during the first phase of the PRMC were aimed at strengthening OPAM, rather than the private sector.
- Mali would continue to experience cereal deficits. This assumption had two implications: official prices, if not raised, would always lie below market prices and act as a brake on production, and food aid would continue to be an appropriate mechanism to fund the reforms.

The experience of the next 6 years showed that all these assumptions, except that "OPAM should continue to exist", were to some degree incorrect.

IMPLEMENTATION AND ACHIEVEMENTS

To achieve the goals of increasing official producer and consumer prices, liberalizing the grain trade, and improving OPAM's operating efficiency, the government, with donor financing, undertook the following actions during the 6 years from 1981-82 through 1986-87:

Actions with respect to OPAM

The pressures leading to the implementation of the PRMC evolved mainly from the progressively disastrous financial situation of OPAM during the 1970s. It is therefore not surprising that most of the actions of the program aimed explicitly at improving OPAM's operations and its management of food aid, in order to reduce or eliminate its financial losses and the need for heavy government budget subsidies. These actions included:

Structural measures

- o Reduction of personnel to lower payroll costs. The number of permanent employees was reduced by 14.4% between 1981-82 and 1985-86, while temporary employment dropped by 97.8% (Table 1). Paradoxically, the total payroll bill of OPAM increased by 18.1% over this 4-year period, mainly because newly hired staff had a higher level of training.
- o Reduction of the vehicle fleet to minimize fixed costs and contracting with private truckers for most regular transport operations. OPAM's truck fleet decreased by almost two-thirds between 1981-82 and 1985-86 (Table 1), resulting in savings of CFAF 41.7 million (20.5%), on depreciation accounts in 1985-86 compared with 1981-82, in spite of a significant increase in the number of OPAM warehouses and amount of other equipment during this period.

Operational measures

- o Improvement of marketing management. The programme provided and supported two expatriates to develop and assist in implementing improved market information and accounting systems for OPAM.
- o Increased access to funding. Of the CFAF 11.7 billion reflow funds beween 1981-82 and 1985-86, 65% went directly or indirectly to or through OPAM (Table 2). The improvement in financing is reflected in the agency's total level of indebtedness, (including short-term loans for working capital), which fell by 48% in 1985-86 as compared with 1981-82--despite a doubling of the volume of coarse grain it traded (82,000 mt in 1985-86 vs 41,000 mt in 1981-82). The reduced level of

Table 1. Evolution of OPAM's personnel and vehicle fleet, 1981 to 1986, Mali.

	1981-82	1982-83	1983-84	1984-85	1985-86
Personnel					
Total	1869	1015	946	828	755
Permanent	869	819	792	820	744
Temporary	500	196	154	8	11
Number of trucks	64	35	23	23	23
Payroll (CFAF million)	270	285	275	302	319
Depreciation (CFAF million)	200	155	155	157	159
OPAM's coarse grains purchases ('000 mt)	41	41	26	25	82
OPAM's share of coarse grains (%)	18	20	15	18	28

Source: OPAM's Report, national seminar on cereal policy (June 1987).

Table 2: Allocation of PRMC food reflow funds, 1981-87, Mali (CFAF million)

Allocation	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
OPAM deficit coverage	452.0	195.0	408.0	0.0	0.0	0.0
IPAM (miscellaneous)	0.0	0.0	0.0	0.0	1,161.5	0.0
Public sector imports	0.0	0.0	425.0	1,211.0	0.0	0.0
National security stocks	0.0	0.0	725.0	0.0	0.0	726.0
Price support through OPAM	0.0	0.0	244.2	247.8	2,454.0	0.0
ON / OPAM	0.0	0.0	0.0	0.0	896.0	539.2
ORS & ORM / OPAM	0.0	0.0	0.0	0.0	0.0	600.0
Office du Niger	0.0	0.0	0.0	152.0	0.0	0.0
Price Stabilisation and Regulation Agency (OSRP)	0.0	0.0	0.0	397.0	550.0	0.0
Studies and Consulting	0.0	0.0	0.0	0.0	0.0	0.8
Private Trader Credit	0.0	0.0	0.0	0.0	0.0	500.0
Farmer Coop Credit	0.0	0.0	0.0	0.0	0.0	500.0
Total funds used	**1,095.4**	**2,840.5**	**3,567.3**	**2,607.3**	**1,815.4**	**11925.0**
Total funds available	**452.0**	**195.0**	**1,802.2**	**2,007.8**	**5,061.5**	**2,873.2**
OPAM's debt	**19,769.0**	**21019.0**	**6,834.0**	**6,545.0**	**10305.0**	**NA**
OPAM's interest cost	**488.0**	**466.0**	**450.0**	**22.0**	**211.0**	**NA**

ON = Office du Niger; ORS = Operation Riz Segou; ORM = Operation Riz Mopti
Source: PRMC Report, National Seminar on Cereal Policy (June 1987)

faced, from CFAF 488 million in 1981-82 to CFAF 211 million in 1985-86.

o Improvement of the overall financial situation. This goal was achieved by a combination of actions, which included:
  - a reduction of physical grain losses from about 12% in 1981-82 to 2.5% for domestic grains and 5% for imported grains in 1985-86 as a result of less but better handling, tighter store security, improved conservation techniques, and enforcement of penalties for losses under private transport contracts;
  - better forward planning to minimize grain shipments;
  - a reduction of fixed truck fleet costs;
  - a reduction of interest costs following Mali's entry in the West African Monetary Union (WAMU); and
  - an increase of the spread between official producer and consumer prices.

These actions reduced OPAM's annual operating deficits, from CFAF 2.6 billion in 1980-81 to CFAF 833 million in 1985-6 (Table 3).

Table 3. Evolution of OPAM's deficit, Mali, 1973-74 to 1985-85. (CFAF million)

Period Year	Deficit	Cumulated Deficit	Subsidies
1973-74	5,922		5,966
1974-75	1,012	6,934	0
1975-76	1,946	8,880	0
1976-77	2,088	10,968	0
1977-78	370	11,338	0
1978-79	2,188	13,526	560
1979-80	4,273	17,799	1,627
1980-81	2,600	20,399	588
1981-82	1,611	22,010	452
1982-83	1,423	23,433	195
1983-84	1,382	24,815	408
1984-85	1,029	25,844	269
1985-86	833	26,677	NA

Source: OPAM's accounts, PRMC Reports.

Trade liberalization

The first official step in grain trade liberalization was a decree signed on December 24, 1981, which authorized any person or association performing a commercial or an agricultural activity--and authorized by the Ministry of Commerce to do so--to trade coarse grains (millet, sorghum and maize) all over the country during the 1981-82 campaign. This decree was followed by two laws in February 1982 that legalized private trade, eliminated OPAM's monopoly rights, and redefined its role as:

- o supplying public-interest institutions (the army, police, hospitals, schools and penitentiaries) and chronic deficit zones;
- o constituting and managing national security stocks of grain;
- o intervening through buying and selling on the market to enforce official producer and consumer prices;
- o managing and distributing food aid.

These official actions led to the elimination of roadblocks, the opening of all coarse grain trade to licensed merchants, and the legalization of private imports without taxes, quotas or restriction of access to foreign exchange. Only private exports of grains remained prohibited. However, the relatively good harvests of 1985 and 1986 induced some waivers in the foreign grain trade regulations: private traders may now export with special authorization of the Ministry of Commerce, while rice imports are temporarily stopped.

Domestic rice trade liberalisation started much later and only progressively in 1984-85. Full private trade in the main rice production zone (the Office du Niger) was authorized only in 1986-87. The slow pace of domestic rice trade liberalization is explained by a combination of factors. Key among them were the resistance of the public sector to abandon its control over such a strategic commodity for its powerful political clientele (army, police and civil servants) and the fear that rice development projects (ODRs) would lose their best loan recovery instrument by giving away their monopoly rights on paddy marketing. Thus, paddy trade liberalization occurred only after these projects were guaranteed that the rice farmers that they supervise remained obligated to deliver to them at least enough rice to repay annual loan instalments.

Changes in official prices

A critical assumption underlying the PRMC price objectives was that official grain prices were set to protect the urban consumer at the expense of depressed producer prices, which in turn constituted one of the main disincentives to increasing domestic cereal production for the market. Therefore, the PRMC assumed that actions to yield a more adequate pricing system should aim at:

- o progressively increasing producer prices, taking into account production costs and the official prices of neighboring countries to inhibit unofficial exports and foster domestic production; and
- o gradually increasing consumer prices to bring them in line with both official producer prices and private-market consumer prices, to avoid the need for consumers subsidies.

These concerns were translated into the programme's price objectives, as shown in Tables 4 and 5. Official producer prices were to increase by 100% for coarse grains and 163% for paddy during the 5-year period extending from 1981-82 through 1986-87. Over the same period, official consumer prices would be raised by 156% for coarse grains and 65% for rice.

However, as shown in the above tables, none of the producer price objectives was met. In fact, by 1986-87, the official producer prices adopted were 21.4% lower than the objective for coarse grains and 30% below the target level for paddy. On the consumer price side, the objectives were met in 1985-86 and 1986-87 for rice, but fell 13.6% below the target for coarse grains in 1986-87. Worse, in real terms, official producer prices were 3.6% lower in 1985-86 than in 1980-81 for coarse grains, and only 11.1% higher for paddy. Official consumer prices in real terms changed by less than 2% for coarse grains and fell by 14.4% for rice between 1980-81 and 1984-85.

These outcomes occurred mainly because:

- o Even before the PRMC, and in spite of the legal monopoly of OPAM, official prices had very little impact on the actual prices producer received or consumer paid for coarse grains. Hence, the program could not completely ignore the market price level in implementing its price policy.
- o Partly because of the drought and also because of rising donor pressures, official producer prices had already been increased by 119% for coarse grains and 90% for paddy during the 4 years (1977-78 to 1980-81) preceding the PRMC. The program could hardly put more upward pressure on prices than had the previous drought.
- o The quasi-total control of rice production and marketing by state agencies, even during almost the entire period of the initial PRMC, guaranteed the success of the program with regard to the consumer price objectives for rice. Moreover, these price objectives were set less ambitiously than those for coarse grains. Whereas the official consumer prices for rice had increased by 78.6% during the 4 years prior to the PRMC (1977-78 to 1980-81), the PRMC itself sought a total increase of 65% over 6 years. The modest targets for nominal price increases in rice reflect the fact that rice represents a significant

Table 4. Official producer prices of coarse grains, 1970-71 to 1986-87, Mali (CFAF/kg).

Period (Year)	PRMC price Objectives (CFAF/KG)		Producer prices in current terms (CFAF/KG)			Producer prices in constant terms (Base year = 1985)		
	Coarse Grains	Paddy	Millet/ Sorghum	Maize	Paddy	Millet/ Sorghum	Maize	Paddy
1970-71	NA	NA	9	10	13	35	39	49
1971-72	NA	NA	9	10	13	35	37	46
1972-73	NA	NA	10	10	13	35	35	43
1973-74	NA	NA	10	10	13	33	33	41
1974-75	NA	NA	16	16	20	50	50	62
1975-76	NA	NA	16	16	20	41	41	51
1976-77	NA	NA	16	16	20	37	37	46
1977-78	NA	NA	18	18	23	39	39	48
1978-79	NA	NA	20	20	25	39	39	49
1979-80	NA	NA	25	25	30	44	44	53
1980-81	NA	NA	35	35	38	57	57	61
1981-82	40	50	43	45	50	62	62	73
1982-83	46	65	45	45	55	62	62	75
1983-84	53	80	50	50	60	62	62	74
1984-85	60	90	50	50	65	54	54	70
1985-86	70	100	55	55	70	55	55	70
1986-87	70	100	55	55	70	NA	NA	NA

NA = not applicable
Sources: PRMC, OPAM and Bureau pour le Development Agricole (BDPA).

Table 5. Consumer prices of coarse grains, Mali, 1970-71 to 1986-87 (CFAF/kg).

Period (Year)	PRMC price Objectives (CFAF/KG)		Producer prices in current terms				Official consumer prices in constant terms (Base year = 1985)	
			Official		Private Market[a]			
	Coarse Grains	Paddy	Millet/ Sorghum	Rice	Millet/ Sorghum	Rice	Millet/ Sorghum	Rice
1970-71	NA	NA	18	39	29	57	65	145
1971-72	NA	NA	18	40	36	62	61	139
1972-73	NA	NA	18	44	58	73	57	144
1973-74	NA	NA	18	44	39	79	54	137
1974-75	NA	NA	26	56	35	75	67	144
1975-76	NA	NA	26	56	36	73	60	130
1976-77	NA	NA	26	56	57	97	56	120
1977-78	NA	NA	29	69	82	145	56	134
1978-79	NA	NA	33	75	54	131	57	133
1979-80	NA	NA	39	90	95	153	63	146
1980-81	NA	NA	43	100	104	165	62	146
1981-82	53	110	58	115	83	171	79	157
1982-83	68	120	63	125	105	163	78	155
1983-84	81	135	63	125	140	177	67	135
1984-85	95	150	63	125	131	174	63	125
1985-86	110	165	95	165	90	173	NA	NA
1986-87	110	165	95	165	NA	NA	NA	NA

[a]Private market prices are for Bamako
Sources: PRMC, OPAM and Bureau pour le Development Agricole (BDPA).

share of the urban civil servant's food budget and therefore constitutes a wage good *par excellence*, and that the prospects for imports of cheap rice could not be ignored by the designers of the PRMC.

It is surprising that one of the main recommendations of the de Meel report of 1978, namely the substitution of the concept of a price band for single panterritorial official buying and selling prices, was not adopted by the PRMC. The main reasons for this may be that the single price system remained appealing because it is operationally easier to implement, and because, for alleged equity reasons, the government resisted the idea of geographical price differences for its employees, who receive roughly the same salary all over the country.

Price support efforts

No reliable market data are available to test whether the PRMC had any effect on actual producer prices during its first 4 years (1981-82 to 1984-85). Nevertheless, the fact that the early 1980s were years of drought and short supply logically suggests that the official producer prices remained significantly below private market prices. Data do exist on the relationship between official prices and market prices at the consumer level, and they indicate that private market prices were 30-55% above official prices for coarse grains (23-30% for rice) during the first 5 years of the PRMC (Table 5).

Furthermore, analysis of the trends and variability in market prices of sorghum and millet in Bamako shows that the initial impact of the PRMC was a sharp decline in millet and sorghum prices (40% and 52%, respectively, in January 1982), mainly due to a significant increase in the total grain supply. The donors' enthusiasm for the program resulted in an increase of food aid by 60% in 1982, despite a 21% increase of domestic production, so that average per capita availability of grain rose by 21% in 1982 over 1981. However, the combined effects of the drought of the early 1980s and the legalization of private trade in coarse grains led to an adjustment process by which market prices rose more rapidly during the first 4 years of the PRMC than over the 4-year period prior to the program (MSU-CESA Working Paper 86- 02).

The first year during which the capacity of the PRMC to support producer prices was put to a true test was in 1985-86 when, thanks to relatively good rainfall, domestic coarse grain production was 72% above the average of the first 4 years of the program. OPAM initially planned to purchase 21,300 mt of coarse grains, but this quickly proved to be too small to affect market prices. The PRMC donor community along with the banking system then stepped in to support OPAM financially, enabling it to buy a total of 82,000 mt of millet, sorghum, and maize. This record-level intervention, which amounted to CFAF 4.5 billion at official producer prices, had a clear impact on private-market producer prices, which remained less than 10% below the official target of CFAF 55/kg even in the most productive southern zones during the 3 to 4 months (December 1985 to March 1986) of official buying operations (Fig. 1). By March, however, OPAM ran out of funds and retreated from the market, leading prices to fall precipitously (MSU-CESA, Working Paper No. 86-03).

After OPAM's withdrawal from the market, rural market prices in the CMDT zone (the major cereal surplus area of the country) never again reached the level of CFAF 50/kg during the 1985-86 crop year (Table 6 and Fig. 1). OPAM's modest overall impact on prices was partly due to the fact that official purchases, despite their high absolute volume, represented merely 5% of total domestic coarse grain production and 28% of total marketed quantities in 1985-86.

Furthermore, not all farmers were positively affected by the price support intervention in 1985-86. Analysis of farmer transaction data (Tables 7 and 8) shows that even in the two most southerly rural development zones (the CMDT and OHV), only 48% of the farms were net sellers of coarse grains versus 39% who were net buyers in 1985-86 (MSU-CESA, Working Paper No. 87-02). Almost 92% of net sales were accounted for by the top 30% of farms units; and 74% of the net sales came from the south of the two zones as compared with 26% in the north. Moreover, farms with a full set of animal traction equipment, representing 36% of the total farm population surveyed, accounted for 70% of total net sales, while semi-equipped farms (35%) and the non-equipped farms (29%) accounted for 21% and 9% of all net sales, respectively. Finally, net sellers were concentrated in the south (59%) and among fully or semi-equipped farms (53% and 29%), while net buyers were mostly found in the north (70%) and among semi-equipped and non-equipped farms (42% and 39%).

From the same analysis, it appears that in the OHV zone, where cash crop production is low, 80% of farmers' coarse grain sales occurred during the 5 months immediately following harvest (November-March). The main motivation for selling at this time, in spite of low prices, was to pay head taxes, which are due by May 31 of each year. Tax payments were cited as the number one reason for sales by 73% of all sellers interviewed in this zone.[4] Taking all these facts into account, it becomes obvious that the

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[4] In the cotton zone (CMDT), most coarse grain sellers pay their taxes out of cotton revenues, which allows these farmers to time their grain sales later in the season, when prices are higher.

FIGURE 1 PRODUCER CEREAL PRICES

MONTHLY AVERAGES F.CFA/KG — SOUTH CMDT

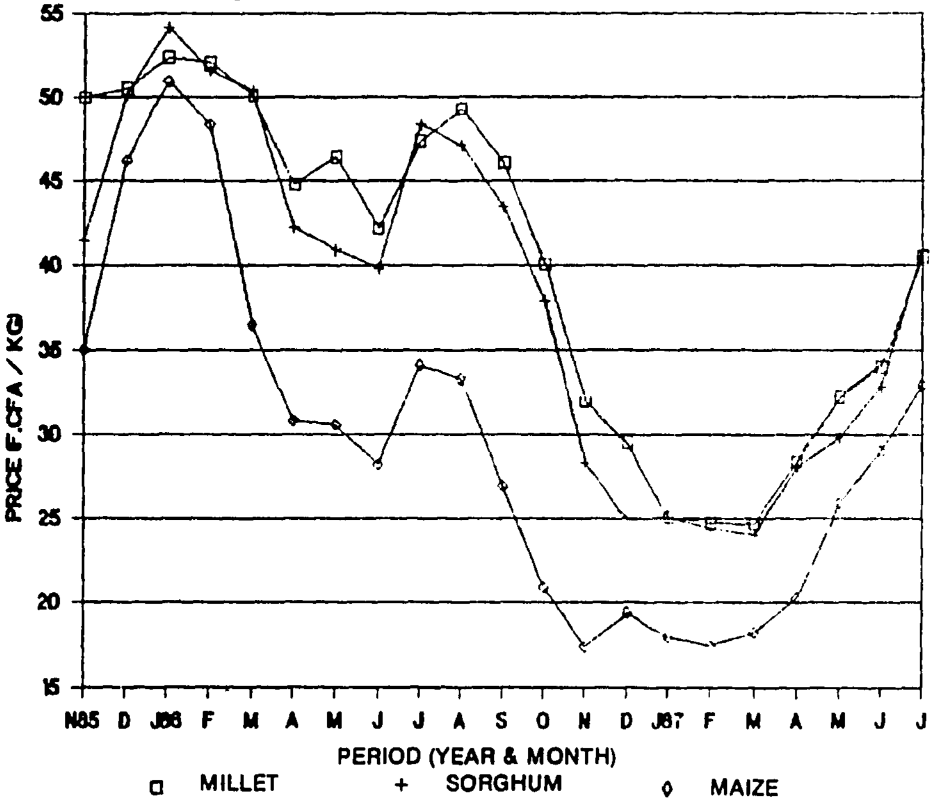

Table 6: Rural market producer prices of coarse grains, Mali, 1985 to 1987 (CFAF/kg)[a]

Period (month)	MILLET South CMDT	MILLET North CMDT	SORGHUM South CMDT	SORGHUM North CMDT	MAIZE South CMDT	MAIZE North CMDT
Oct. 1985	50.0	55.0	40.0	50.0	27.5	27.5
Nov. 1985	50.0	50.0	41.5	45.0	35.0	30.0
Dec. 1985	50.5	52.5	50.2	52.5	46.2	52.6
Jan. 1986	52.4	52.8	54.2	51.3	51.0	51.0
Feb. 1986	52.1	50.7	51.6	50.6	48.4	51.6
Mar. 1986	50.1	53.0	50.4	51.5	36.5	48.9
Apr. 1986	44.8	45.3	42.3	46.0	30.8	35.0
May. 1986	46.6	41.8	41.9	42.0	31.4	NA
Jun. 1986	42.2	39.2	39.8	39.6	28.2	32.1
Jul. 1986	47.4	46.0	48.4	46.2	34.1	27.9
Aug. 1986	49.3	48.8	47.1	49.5	33.3	35.0
Sep. 1986	46.1	44.3	43.5	45.0	26.9	24.1
Oct. 1986	40.1	32.0	37.9	30.8	20.9	20.0
Nov. 1986	32.0	25.1	28.3	26.8	17.4	22.5
Dec. 1986	29.5	26.4	24.9	25.9	19.4	27.5
Jan. 1987	25.1	25.5	25.1	25.4	18.0	15.6
Feb. 1987	24.7	20.4	24.5	23.9	17.4	15.0
Mar. 1987	24.7	20.3	24.0	24.6	18.2	NA
Apr. 1987	28.4	27.6	28.1	29.2	20.3	15.0
May. 1987	32.2	32.7	29.8	32.2	25.9	18.8
Jun. 1987	34.0	32.1	32.8	32.4	29.0	20.0
Jul. 1987	40.5	42.6	40.9	43.2	32.9	NA

[a]Weighted monthly average prices, NA = not applicable.
Source: MSU-CESA Food Security Project (1985 to 1987).

able 7. Coarse Grain sales, Mali, 1985-86.

ZONES SUB-ZONES STRATA	Farms Selling (%)	Average Sales per Farm (kg)	Production Sold (%)	Total Net Sales (%)
South - CMDT	68.8	457	10.4	70.4
North - CMDT	64.6	166	5.6	19.9
South - OHV	56.3	49	3.0	3.2
North - OHV	50.0	119	8.9	6.5
MDT 7 OHV By stratum				
quipped farms	79.9	433	9.0	70.4
mi-equipped non def.	77.3	241	7.3	18.0
mi-equipped deficit	45.4	56	3.3	2.6
on-equipped farms	52.9	89	7.9	9.0

ource: MSU-CESA Food Security Project, farm surveys (1985-86).

ble 8. Concentration of coarse grain sales, survey areas, Mali, 1985-86.

GROSS SALES		NET SALES	
Percent of farms	Percent of sales	Percent of farms	Percent of sales
4.7	36.1	4.7	41.0
9.9	49.9	9.9	55.5
14.9	60.9	14.9	67.7
20.4	69.8	20.4	77.6
24.9	67.4	24.9	84.7
30.1	84.4	30.1	91.9
35.3	89.9	34.9	95.9
39.7	93.0	40.0	98.5
45.1	95.5	45.0	99.7
49.9	97.7	47.6	100.0
55.1	99.1	NA	NA
59.9	99.9	NA	NA
64.3	100.0	NA	NA

ource: MSU-CESA Food Security Project, farm surveys (1985-86).

price support effort mostly benefited fully and semi-equipped farmers of the cotton producing southern zones; while hurting a large number of semi-equipped farms and almost all non-equipped farms in the non-cotton producing zones, where most farmers are net buyers--even in a good rainfall year such as 1985-86.

Finally, the official intervention of OPAM to support producer prices in 1985-86 induced a distortion in the seasonal pattern of prices (Fig 1). Market producer prices rose to and remained around CFAF 50/kg during a few months of the immediate postharvest period when OPAM was actively buying, then dropped to levels which never reached the December-March peak for the rest of the campaign. This distortion created a significant disincentive to private traders' investment in grain storage which, combined with their very limited access to formal credit, discouraged private storage (MSU-CESA, Working Papers No. 86-04 and 86-05). Hence, the way the PRMC attempted to meet its price support objective conflicted with its goal of seeking more active private involvement in domestic grain marketing.

OPAM's market intervention in 1986-87 was much more limited than in 1985-86 because of inflexibility in the rules governing its commercial operations. Due to the bumper harvest, market prices were significantly below official prices at the consumer level throughout 1985-86. Nonetheless, OPAM was forced to sell at the official price. Because OPAM found few customers at the official price, most of its working capital was tied up in unsold grain stocks, which prevented the grain board from making significant purchases in 1986-87.[5] OPAM's actions in 1986-87 included only the purchase of 10,000 mt of coarse grains to replenish the national cereals security stock.

Direct actions with the private sector

Most observers agree that the PRMC did very little in terms of actions aimed at directly improving the private sector's capacity to market cereals efficiently. This fact is nicely stated in a USAID consulting assessment, which notes that "the ambiguity of policy reform is reflected in the ironic situation in which the PRMC program--with a major focus on increasing pri-

[5]Part of the pressure to sell only at the official price came from the PRMC donors, who did not want losses on lower-priced sales to show up on OPAM's books and make the programme look as though it was not achieving its aim of improving OPAM's efficiency. Although OPAM was actually losing money on storing the grain, OPAM's balance sheet did not reflect these losses, because the inventory was valued at the unrealistically high official consumer price.

vate sector participation in a freer cereals trade--has spent most of its expatriate staff time and financial resources attempting to keep the state trade agency afloat" (Wilcock, Roth, and Haykin, 1987).

This contention is confirmed by the fact that OPAM benefited directly or indirectly from 65% of all PRMC food aid reflow money from 1981-82 to 1985-86, in addition to two full-time expatriate experts. Furthermore, thanks to the donors' financial commitment, the state grain marketing agency's market share rose to 28% in 1985-86, a level not reached since 1978-79, and an all--time record in terms of the quantity of coarse grains purchased by the official system.

With the exception of the legalization of the private trade, the PRMC undertook virtually no direct activity in favor of private grain merchants or producer associations before the 1986-87 campaign. The benefits of liberalization gained by the private traders included more freedom of action; the subsequent increase in the scale of their activities resulting in reduced operating costs (especially reduced transaction costs) and possibly higher profits. Meanwhile, MSU-CESA Food Security research data indicate that in 1986, 63% of coarse grain wholesalers in four major trading cities (Bamako, Mopti, Sikasso and Koutiala) complained about the low level of their working capital and their limited access to formal financing institutions; 55% of them pleaded for a reduction in their business taxes, which were the equivalent of 55% of their net revenue; and 15% reported the search for financing to acquire trucks or warehouses as their major concern. In addition, almost 25% of these wholesalers complained about the cost incurred due to frequent public inspections by the *controle economique*, resulting often in arbitrary and unofficial fines.

With the good harvests of 1986, which resulted from a second good rainy season in a row, the PRMC policy makers realized that because of constraints in both the public and the private marketing channels, the Malian cereal market was facing gridlock. By fixing official consumer prices too far above market clearing prices, the state put OPAM in a situation where it could hardly sell any of the grain it bought in 1985-86. With its huge carryover stocks and resulting debt (CFAF 10.3 billion), OPAM had neither available storage space nor the required financial capacity to intervene effectively in a collapsing coarse grain market in 1986-87. Furthermore, because of limited financial capacity and uncertainty about what OPAM would do with its stocks, private traders were both neither able nor unwilling to buy and stock large quantities of grain in anticipation of a seasonal price rise.

To at least partially solve the problem, the PRMC donor community agreed to support a credit program of CFAF 1.0 billion, half for private traders (and implemented via private banks and the Chamber of Commerce and

Industry), and half in favor of village producer associations. For the private merchants, the banking system was requested to match the PRMC's CFAF 500 million with an equal amount, but it was forbidden to do so by the Central Bank of West African States (BCEAO), which had imposed an overall limit on credit creation by commercial banks in order to curb inflation. Therefore, this first attempt at direct action to help private cereal market agents was modest in its focus and impact. Indeed, the credit program could cover merely 14,000 mt at the wholesale level and an additional 25,000 mt at the village association level.[6] These 39,000 mt, when added to the 10,000 mt purchased by OPAM with PRMC funds for the national security stock, represent approximately 16% of the marketable surplus of 300,000 mt of coarse grains in 1986-87.

Beside the modest level of financing, private merchants complained about the delay in availability of funds at the bank-level (the loan process started only in March, 4 months after harvest); the long and slow administrative procedures of loan processing; the provision of funds in small disbursements, which did not permit traders to finance large-scale operations; and the non-involvement of the Chamber of Commerce in loan application procesing. This test credit program is presently under evaluation by the MSU-CESA Food Security project and USAID in order to generate useful information and recommendations for reshaping it for the next campaign (1987-88).

PRMC program monitoring

Most of the shortfalls of the PRMC can be blamed on the weak empirical basis upon which the program was designed, implemented, and periodically assessed. In designing the program, the government and the donors had very few studies on the structure, conduct and performance of the Malian cereals market on which they could draw. Moreover, most of the previous reports and studies were heavily biased toward the description of the state marketing system and provided very little insight into the private market. Hence, almost all the initial package of actions of the PRMC was defined not on the basis of facts but on assumptions about how the private trade was organized, how it operated, and how it performed.

Nevertheless, the PRMC donor group made a remarkable effort to monitor the program throughout its implementation. On an *ad hoc* basis, the donor Technical Committee met almost weekly to discuss program progress and

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[6] These quantities are estimated by dividing the total loan funds available for each component by the post-harvest prices at both the wholesaler and village levels in the major cereals producing zone.

reach agreement on how to reshape current activities and define new lines of intervention. In addition, many donors sponsored annual assessment and evaluation missions, carried out by outside consultants over the 6-year period (1981-82 to 1986-87), which led many observers to note that the PRMC is doubtlessly among the most evaluated programs in Africa!

However, these *ad hoc* and outside evaluation efforts could not generate the appropriate data required for a thorough monitoring of the program. The major weakness of the monitoring process was that except for consumer price data, which are collected monthly in all regional capitals and each 10 days in Bamako, the program monitoring teams had practically no usable data on the private market until 1985. The lack of basic data on the private cereals market explains in large part the weakness of most PRMC evaluation reports. For instance, because no data are available on actual producer prices prior to 1985, it is impossible to assess the impact of the program on farmers' income during its first four years (1981-82 to 1984-85).

It was only in 1985 that the Canadians and Americans decided, as an additional contribution to their participation in the policy reform process, to support major data collection and analysis activities to inform the PRMC. The Canadian International Development Agency (CIDA) provided an agricultural economist who not only served as Canada's representative on the Technical Committee, but also undertook primary data collection in a few major rural markets in the administrative subdivision of Diola (between Bamako and Segou), as well as case studies of the operations of a few private grain wholesalers in Bamako. This effort generated weekly producer price data (though very limited geographically) and a few analyses and reports based on primary data on private market channels and behavior (Gagnon, 1986).

The most important monitoring-related research activity to date was initiated in 1985 through the MSU-USAID Food Security in Africa Cooperative Agreement which, in Mali, was implemented as a joint project with Mali's National Commission for the Oversight and Evaluation of the Food Strategy (CESA). The aim of the MSU-CESA research was to develop a better understanding of the structure, conduct and performance of the private market for domestic coarse grains and, in so doing, empirically test some of the major assumptions underlying the PRMC. Since the inception of this research project in October 1985, the research team has collected, processed, analyzed and disseminated basic information on the private market for coarse grains.

The data generated by the MSU-CESA Food Security Project cover a large set of market conduct and performance indicators, including:

- o monthly coarse grain transactions (sales, purchases, barters and gifts) for a sample of 190 farmers distributed among 16 villages in 4 rainfall subzones in the south of the country the (CMDT and OHV zones);

- o weekly transaction data for the main rural market of each of the 4 subzones; and
- o monthly transaction data for a sample of 101 grain wholesalers in 4 major cities (Bamako, Mopti, Sikasso and Koutiala).

In addition, several one-shot surveys have been carried out to gather information on farmers' strategies for coping with their own food security (available resources, activities and means to meet food needs, major constraints that jeopardize their food situation, major policy and technological factors that enhance their food security, etc.); traders' resources, constraints, and strategic behavior, especially in response to the risk and uncertainty that traders face from unexpected policy changes and supply variability; and the interactive effects of different macro-level policies (fiscal, credit, pricing, extension, etc.), on both traders' and farmers' strategies with respect to their production and marketing activities.

The information and analyses from this project flowed directly to the PRMC policy makers through the USAID representative to the PRMC Technical Committee, regular meetings between the project's researchers and this committee, periodic debates organized around working papers with CESA, meetings with outside consultants, and participation of the project's lead researcher in national and international seminars and workshops on cereals policy.

EVALUATION OF ACHIEVEMENTS AND IMPLICATIONS FOR THE SECOND PHASE OF THE PRMC AND FOR MARKET REFORMS ELSEWHERE IN AFRICA

Achievements of the first phase of the PRMC

The PRMC achieved encouraging results during the six years of its initial implementation phase; however it was not a complete success. Despite the progressive liberalization of domestic trade and imports of cereals, many aspects of the private trade remain heavily regulated: freedom of entry in grain trade is restricted to some extent by the demanding requirements that an individual must meet to obtain a trading license (minimum bank deposit, proper storage, etc.); exports require licensing under a very long and cumbersome administrative process; and private traders' access to formal financing is severely limited.

Given the lack of data on producer prices in the private market before PRMC and during the first 4 years of the program, it is virtually impossible to quantify the impact of the policy reform on farmers' incomes. One may speculate that by increasing the number of merchants buying cereals from producers, the market liberalization increased competition among buyers, with the consequence of increasing producer prices to some extent. Similarily, during the deficit years of 1981-82 and 1984-85, deficit producers probably benefited directly or indirectly from the effect of food aid on consumer prices. In the bumper crop year of 1985-86, strong financial support by the donors allowed OPAM to buy considerable quantities of cereals at official prices, which were higher than prevailing market prices. This led to a transfer of income from the donors to those surplus producers who sold during the OPAM buying campaign.

Of all the parties concerned, the state appears to have gained the most from the activities of the PRMC during its initial phase. OPAM benefited from the sales of food aid by using the reflow money to cover its annual deficits and to finance its price support operations. It was also the recipient of almost all the technical assistance provided by the donors. OPAM also gained from the increase in its margins permitted by the revision of the official price schedules. In addition to its actions toward OPAM, the PRMC also provided financial support to other public agencies, such as the rice producing Office du Niger and the Price Stabilization and Regulation Office (OSRP).

The PRMC increased consumers' access to cereals at lower prices, thanks to the combination of greater competition among private traders, freer movement of cereals within the country, the liberalization of imports, and the increase and improved coordination of the food aid provided by the donor group supporting the program.

However, mainly due to design and implementation shortfalls, many problems remain to be tackled if the performance of the whole system is to improve. First, greater program and policy flexibility is needed at several levels:

- Administrative and regulatory burdens (e.g., in obtaining export clearances) continue to inhibit private traders' ability to adjust quickly to volatile market conditions. The volatility of the markets results in part from uncertainty about what actions the public sector is planning to take in these markets.
- Official prices, if retained at all, need to be linked to market prices, particularly if OPAM is constrained to buy and sell at official prices. Otherwise, during years of short harvests, such as 1984-85, market prices will lie above official prices, creating few incentives for producers to sell to OPAM but increasing the incentives for consumers to try to buy from OPAM at the subsidized official consumer price. In years of good harvests, such as 1985-86, just the opposite occurs. In both cases, OPAM loses.
- Flexibility is needed with respect to the financing of the PRMC itself. Whereas using food aid to finance cereal market reform may make

sense in years of substantial production shortfalls, as occurred during the first 4 years of the project, it creates disincentives for both farmers and private traders in years of good harvests, when market prices are already likely to be depressed--even in the absence of inflows of food aid. The donors have begun to address this problem; in 1987, the US contributed US$1 million in cash to the PRMC in lieu of food aid.

Second, private traders face severe financial constraints that prevent them from undertaking larger scale cost-saving operations and investing in means to achieve better vertical coordination of their activities, especially improved transportation and storage facilities. They also lack adequate market information that would enable them to plan their business operations more effectively, such as timely information on market prices; public and private stocks; timing and level of planned public-sector purchases and sales; domestic production; current and projected imports; the place, timing, and level of nongovernmental organizations' food aid interventions; and ongoing changes in current policy directions.

Third, despite remarkable progress, OPAM's costs remain high. In fact, significant savings were made only on fixed costs, due mainly to the sharp reductions in the agency's truck fleet and in interest costs, thanks to the PRMC funding. Payroll costs increased both in absolute and relative terms during the first 5 years of the program (Table 9). OPAM now faces the

Table 9: Evolution of OPAMs cost structure, Mali (1980-81 to 1985-86).

Period (year)	Total Costs (CFAF million)	Percentage share of:				
		Payroll Costs	Deprec-iation	Payroll & deprec-iation	Trans-port costs	Interest costs
1980-1981	2,046	12.8	11.3	24.1	30.5	24.6
1981-1982	1,965	13.7	10.2	24.0	30.7	24.9
1982-1983	1,877	15.2	8.3	23.5	27.9	24.8
1983-1984	1,708	16.1	9.1	25.2	21.5	26.3
1984-1985	1,141	6.6	13.4	40.0	21.0	1.9
1985-1986	1,825	16.8	8.7	25.5	38.6	15.2

Source: OPAM's accounts. PRMC reports.

problem of being simultaneously overstaffed quantitatively and understaffed qualitatively. It still lacks the analytic capacity to properly plan and manage its activities.

Fourth, the combination of price supports and fiscal policies (head taxes) reduced the food security of more than one-third of the farmers in the major cereals producing region who are net grain buyers. These include mainly small farm households with little or no animal traction equipment, which may have the highest propensity to invest in farming in order to raise their agricultural productivity. However, they are unable to do so, because they find themselves in a poverty trap where they have to rely heavily on their small cereal production to pay taxes and loans at harvest time, and rebuy cereal at higher prices (often on credit) to feed themselves during the hungry season. Therefore, this class of farmer is never in a position to adopt a sales strategy that would allow them to maximize their income and save.

Fifth, the above remark points out a more general constraint to relying solely on market liberalization to overcome poverty and hunger problems; namely that a large number of urban and rural consumers, including small wage earners, unemployed rural migrants, and many farmers, lack adequate income to assure access to the cereals market. The full potential of the PRMC is unlikely to be achieved unless the program is accompanied by efforts to increase incomes and hence the effective demand for cereals. This requires attention to increasing productivity in food, cash-crop, and livestock production; promotion of non-farm enterprises; and urban job creation. The synergies between food crop production and other enterprises require particular attention; the findings in Mali indicate clearly that rural household food security was highest among those families with greatest involvement in cotton production and off-farm activities.

Implications for the second phase of the PRMC and the design and implementation of marketing policy reforms elsewhere in Africa

The PRMC was initially funded for 5 years, from 1982 through 1986. In 1986 the donors agreed to a 3-year extension of the program, through 1989. What lessons can be drawn from the experience of the first phase for subsequent PRMC activities and for similar programs elsewhere in Africa?

The most apparent lesson that emerges is the critical importance of having reliable knowledge about how the food system works in order to design effective food policies. The lack of empirical information on the cereals subsector was clearly one of the major weaknesses during the initial design of the PRMC and the first 4 years of implementation. Without such information, it was impossible to test the basic assumptions on which the project was based concerning private traders' capacity to respond to opportunities opened up by liberalization, farmers' net selling positions, merchants and farmers' reactions to prices, their market related constraints, etc. Most of the initial assumptions ended up being wrong to some degree, necessitating ongoing modification of the program.

The required understanding of the food system is unlikely to be obtained by relying solely on short-term external consultants. Not only are external consultants often unaware of many of the subleties of how the local food systems work, but also they are constrained to work with the existing data base, which is often inadequate. Without investing in increasing the in domestic capacity to generate and analyze information on the food system, policies will continue to be made largely out of ignorance.

The experience of the PRMC suggests that the following types of information are critical in designing successful market liberalizations and related reforms:

- o Prices paid and received at various stages in the subsector.
- o Cost data at various stages in the subsector, which, when combined with the price data and data on trader practices, allow estimation of traders' margins.
- o Information on the likely incidence of proposed policies. For example, in evaluating a proposed price support program it is critical to know what proportion of farmers are net sellers, how many are net buyers, and what are the characteristics and sales strategies of each.
- o Enough information on farmers' and traders' strategies and constraints to interpret observed fluctuations in prices and quantities sold. For example, what influence do tax obligations have on farmers' seasonal sales strategies and hence the seasonal pattern of prices? What are the determinants of traders' storage strategies? This information is also critical in assessing how market participants will react to policy changes.

Research needs to focus on testing the basic assumptions underlying the reforms. At the same time, researchers must to be highly selective in determining which variables to observe, as it is easy to fall into the trap of collecting too much data, which prevents timely analysis and feedback to policy makers.

In Mali, as in most African countries, the question of what role the state can and should play in cereal market stabilization remains an important topic for future research. Instability in these markets probably discourages farmer and trader investment and specialization in the grain subsector, but given the very limited financial resources of most African countries and the thinness of the markets, the feasibility of running a price support program through grain board purchases is highly questionable. Despite strong donor support, OPAM's attempts at enforcing an official producer price above the market price were largely unsuccessful. What alternative roles the state, with its very limited resources, could play in reducing the volatility of cereals markets remains an area for both theoretical and empirical investigation.

The PRMC experience also points out that generating empirical information to inform the policy reform process involves much more than just data collection and analysis. Considerable effort has to be invested in creating channels to feed back research findings in a timely way to policy makers. Elaborate reports presented after 2 years of analysis are frequently useless to policy makers, as the issues they analyze are often out of date. In addition to emphasizing timely analysis (which has important implications for the types and amount of data collected), researchers may initially have to devote considerable energy to "selling" their results. In Mali, there was no tradition of issuing preliminary results in the form of working papers, and Malian policy makers were at first skepitical of these reports and slower than the donor Technical Committee to grasp the usefulness of their findings for policy design. However, after the project director spent considerable time interacting with members of the Malian Food Strategy Commission Malian policy makers became strong advocates of the need to foster local research capacity to inform policy.

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HOUSEHOLD FOOD INSECURITY IN SORGHUM BASED FARMING SYSTEMS IN THE SADCC REGION

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MAJOR ISSUES IN DESIGNING A RESEARCH PROGRAMME ON HOUSEHOLD FOOD SECURITY

M. Rukuni and R.H. Bernsten[1]

INTRODUCTION

Over the past decade, the economies in Southern African have experienced difficulties in meeting the food needs of their population. The reasons for household food insecurity include exogenous factors such as drought, high oil prices, and declining terms of trade for cash crops and raw materials; civil strife; lack of appropriate technology; poor performance of supporting research, credit, marketing and extension institutions; and inappropriate agricultural and macroeconomic policies. Morover, under conditions of rapid population growth, pressure is placed on the natural resource base--leading to resource degradation which threatens the sustainability of agriculture in future years (Eicher, 1986; Jayne, *et. al.*, 1987). Due to these factors, the food security of many rural households throughout Southern Africa is at risk.

THE EVOLVING FOOD SECURITY RESEARCH PROGRAMME

In 1985, a Cooperative Agreement between Michigan State University and USAID provided funding to initiate reseach on food security in Senegal, Mali, Somalia, Rwanda, and Southern Africa. The Southern Africa collaborative research program was first established in Zimbabwe with the University and subsequently expanded to support research in Botswana, Malawi, and Tanzania.

Papers presented at the 1986 conference on Food Security in Southern Africa (Rukuni and Eicher, 1986), the evaluation session following the conference, and a regional methodology workshop in March of 1987, identified household food insecurity in low-rainfall regions as a high priority research topic. In response to this assessment, a decision was made to expand the time allotted to household food security issues at this conference.

This session, and the following two sessons, will report on research in progress by SADCC researchers addressing issues of production, income gen-

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eration, and transfer programs to increase access to food by rural households.

This morning's session provides a broad orientation to household food security issues. Zinyama, Campbell, and Matiza will review how African households have historically coped with food insecurity; and how these strategies have become more dependant on the external cash economy. Mushonga will update us on sorghum research in progress in Zimbabwe, collaborative sorghum research under the SADCC/ICRISAT program, and prospects for increasing the productivity of sorghum-based farming systems. Reporting on initial research in low-rainfall districts in Zimbabwe, Mudimu, Mbwanda, Govereh, and Chigume highlight the implications of their findings for future research--emphasizing the need for additional research on small grain and oil seed production; and increasing household and off-farm utilization of small grains. Providing a valuable regional perspective, Norman, Segwele, and Baker report on the results of two decades of research on sorghm-based farming systems research in Northern Nigeria and Botswana.

The papers in the session, Communal Maize Production, Storage, and Marketing in Zimbabwe: Implications for Policy makers, highlight the major contribution of rural income and employment generation to ensuring household food security. Rohrbach reports on factors responsible for tripling maize production in Zimbabwe since 1980. Particularly interesting is his evidence that rural households have not benefitted equally from this increase in production; and that the increase in maize production and marketing has varied widely between regions and household within regions. Stanning's analysis of household grain storage and marketing decisions in surplus and deficit communal areas provides evidence that the level and composition of household grain transactions and income varies considerably between households.

Because of drought, several African countries have institutionalized government food-transfer programs. Two papers will be presented in this afternoon's session on Access to Food. Botswana, now in the sixth year of drought, took a decision in 1979 to develop a permanent institutional capacity to cope with drought and household food insecurity. The important question for conference participants is as follows: Can Botswana's food access programs be replicated in other SADCC countries? Central to this question is the cost of alternative food-transfer programs. Mokobi and Asefa analyze Botswana's experience in meeting both rural and urban food needs during the past six years of drought. Since poverty is a central cause of household food insecurity and malnutrition, Liedholm will present a paper summarizing empirical research on rural nonfarm employment activities as a source of employment and income to purchase more food. Today's sessons will provide an opportunities to jointly share methodologies and results and discuss future research priorities.

ISSUES IN IMPLEMENTING HOUSEHOLD FOOD SECURITY RESEARCH

Several issues must be addressed in developing a household food security research program. In this presentation, these issues are raised as a series of questions. The proposed answers reflect our experience in implementing household food security research and are intended to serve as a point of departure for further discussion.

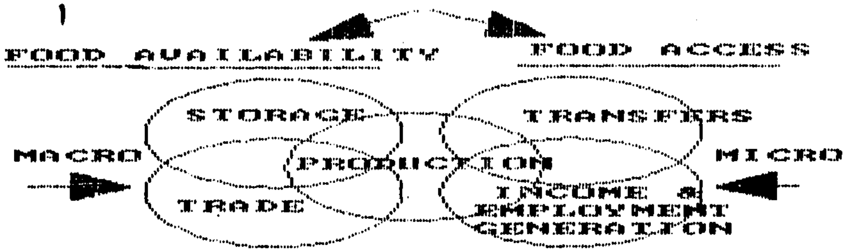
What does household food security mean?

Food security is defined as the ability of all households in a nation to acquire a calorie-adequate diet throughout the year. Food security has two interrelated components: food availability through production, storage or trade; and access to food through production, purchases in the market from income earned, or food transfers (Figure 1).

On the supply side, food insecurity results from the food system's inability to provide an adequate supply of food--both in terms of volume and at an affordable cost. On the demand side, food insecurity arises from the inability of the economy to either provide income-generating opportunities to enable households to purchase in the market or acquire food through transfers.

While food security research may focus on the region, nation, or household; the household food security research perspective places major emphasis on analyzing household data and the performance of institutions in assuring household access to food. Analysis of micro data provides a basis to assess macroeconomic policies on household food security.

FIG. 1 FOOD SECURITY EQUATION



What time period should we consider?

Food insecurity has both short-run and long-run dimensions. Short-run food insecurity results from intra and interseasonal shortfalls in food supplies and effective demand for food. Long-run food insecurity arises from a persistent failure of the economy to assure stable, long term growth in food supplies--especially for nutritionally at risk groups--as population increases and consumer demands change as a consequence of income growth and urbanization.

What are the components of household food security?

Household food security may be conceptualized in terms of a hierarchy of subcomponents. At the first level, access to food depends on households' own production, the availability of income to purchase food, and food transfers (Figure 2). Secondary components of own production include net crop and livestock flows. Secondary components of income generation include sales of farm product (food and cash crops, and livestock) and labor services. Finally, secondary components of food transfers include interhousehold and institutional transfers that provide a safety net for at risk households. A major challenge facing household food security researchers is how to include rural nonfarm activities in our analysis (Leidholm and Mead, 1987). Household strategies for assuring food security are conditioned by households' resource and preferences. External factors influencing these strategies include agroclimatic conditions, technology, institutional performance, and government policies.

Figure 2. Components of Household Access to Food.

FOOD ACCESS COMPONENTS

Production (net)	**Income Generation**	**Transfers**
Crops	*Farm Sales*	*Inter-household*
o land	o food crops	*Food Aid*
o labor	o cash crops	o food-for-work
o technology	o livestock	o school feeding
o management	*Labor Sales*	o relief
	o non resident	
Livestock	o resident	
	on-farm	
	non-farm	

How do we identify relevant household food security research issues?
Major audience for our research results include policy makers, government administrators, technical scientists, and private sector decision makers. In designing the research, the team consulted with a broad mix of representatives from these groups to insure relevance and involve them in the ongoing research.

What are appropriate research objectives?
Household food security research focuses on both sides of the food security equation: food availability and access to food. The general objective of household food security research is to identify priority farming systems and initiate research to:

- o diagnose the historical and current household food security situation largely through collecting and analyzing household data;
- o describe the agroclimatic and policy environment--particularly technology, institutional, and price policy--that condition existing household resource allocation patterns;
- o identify major technological, institutional, and policy constraints on improving farming systems in low-rainfall regions--including on and off-farm processing;
- o analyze the impact of government policies and programs on food production and access to food; and
- o assess the potential impact of policy interventions to increasing household food security.

How do we insure an efficient research design?
Early in the program, our University of Zimbabwe research team recognized that microeconomic data for analyzing household food security issues were not available. Consequently, the Co-Directors decided to make a major investment in primary data collection. Several research design and management strategies have been used to facilitate efficient project implementation.

Detailed research proposals were developed that included a problem statement, research questions, objectives, methodology, manpower and financial requirements, implementation timetable, and a preliminary list of intermediate working paper. These proposals have served to insure a consistency between research objectives, methodology, and data needs.

The research has been initiated at selected representative sites in target agroecological regions. First, secondary data were reviewed to identify possible sites that met the criteria specified in the research designs, including type of farming system and access to marketing infrastructure. Research sites were selected to represent variations in farming systems and market access to facilitate comparative analysis of the impact of these situational variables on household food security.

Currently, a team of six researchers is implementing several different but related studies at a common set of research sites. Analysis of subsets of the data is assigned to each participant who will use the data to develop postgraduate theses and dissertations.

How do we gain interdisciplinary research cooperation?

Relevant household food security research requires an input from related disciplines. This input has been provided by agronomists, plant breeders, geographers, agricultural engineers, food scientists and policy makers through seminars and individual consultations. Recently, three geographers have joined the research team and we anticipate expanding the team to include individuals from other disciplines as appropriate opportunities arise.

What are appropriate methods for analyzing household food security?

Several analytical approaches have been used to analyze household food security issues. First, agricultural policies affecting the low-rainfall areas were reviewed. Subsequently, secondary data on production components (area and yield), product marketings, and commodity prices were analyzed to identify trends and to generate hypotheses for further testing at the household level.

Several approaches have been used to evaluate access to food at the household level; and the differential impact of technology, institutions, and price policies across research sites, including the following:

- o Key informant and household surveys were used to collect current and historical cross-sectional data to document the introduction of major technical, institutional, and price policy interventions; and producers' response. Analysis related the timing of these interventions to household resource allocation decisions (adoption of technology and changes in area planted); and the impact of these decisions on crop yields, retentions, marketings, and household income.
- o Crop budgets, based on historical and current input levels, prices, and yields were developed to evaluate the impact of changing relative prices on the economics of household crop production.
- o Household strategies to cope with food insecurity were assessed through direct inquiry; and income data was analyzed to assess the importance of income diversification as a hedge against production risk --including the role of cash crops, remittences, and transfers.

The impact of policy interventions on households were analyzed by quantifying the interhousehold distribution of resources (land, labor and capital), access to institutional support, and benefits gained as a consequences of policy changes.

PRELIMINARY INSIGHTS ON HOUSEHOLD FOOD SECURITY

Analysis of the Zimbabwe household food security data is still in progress. Initial results--and results from similar studies in progress in Senegal, Somalia, Mali and Rwanda--include the following:

- o While food crop sales are a major source of income in areas studied, remittances, livestock sales and wages from off and nonfarm labor are important income sources. The level and composition of these sources varies greatly between households and regions.
- o Marketed surplus varies considerably between years, regions, and households. In favorable rainfall years, the marketed surpluses stretches the capacity of governments to procure, store, and dispose of these surpluses--particularly for small grains for which there is limited demand at current prices.
- o In drought prone regions, government food-for-work and other food transfer programmes are important sources of food security for the most at risk households.
- o Household access to institutional support which facilitates the adoption of new technology varies between regions and between households in a given region.
- o Unreliable rainfall is a major source of risk. Interyear yield variability is extremely large, even though farmers have adopted coping strategies such as staggered planting, crop mixes, and intercropping to reduce this risk.
- o Farmers have adopted yield-increasing technology (hybrid maize and fertilizer) where, under farmers' conditions, it is profitable. Adoption has lagged, in more risk-prone low-rainfall areas.
- o Household labor is a major production input. Using gross margins per person day as an indicator of profitability, daily returns to labor is quite low--compared to the minimum wage in urban areas.
- o Government policies to support research, strengthen extension services, provide credit to smallholders, extend the marketing infrastructure into the communal areas, and provide farmers with remunerative prices have all contributed to the recent production increases.

FUTURE DIRECTIONS

Household food security research needs to continue its focus on low-rainfall farming systems as these households are at greatest risk. Additional production-oriented research on small grains is needed to improve household food security. The technical, institutional, and policy constraints to increasing cash crop production--especially oilseeds and horticultural crops, as well as small ruminants--should be investigated. Research on small-scale irrigation is needed to assess its potential for providing households with a stable environment for high-value cash crop production. Finally, the role of credit and savings in facilitating technology adoption needs further investigation.

Greater emphasis should also be placed on income and employment generation through the expansion of small-scale enterprises, food processing, and opportunities to add value to raw agricultural products--possibly through expanding poultry or semi-intensive livestock production. As pressure on land resources intensifies, rural off-farm employment generation is critical to dampening rapid urban migration.

Because of the importance of food transfers in providing food security to at risk households during drought years in both Botswana and Zimbabwe, research is needed to determine the most effective ways to identify at risk households and the cost-effectiveness of programs such as food-for-work and school feeding.

Finally, sorghum and millet surpluses call for studies on ways to increase the demand for these grains through increased utilization in poor households, in food-for-work programs, as animal feeds, and in industrial products.

THE CHALLENGE BEFORE US

The papers presented during these sessions will contribute to the debate on relevant research priorities in household food security research. Results presented will show a great deal has been learned about household food security, but that we still have much to learn. Discussion during the coming days will help to refine the household food security research agenda for Southern Africa and move us towards a better understanding of how to insure household food security.

In the coming year, the Food Security Project will to explore opportunities to broaden the community of researchers involved in household food security research. The problem is of critical importance, the issues are numerous, and the challenge is before us.

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TRADITIONAL HOUSEHOLD STRATEGIES TO COPE WITH FOOD INSECURITY IN THE SADCC REGION

L.M. Zinyama, D.J. Campbell, and T. Matiza[1]

INTRODUCTION

The late 1960s ushered in a prolonged period during which Sub-Saharan African countries have found it increasingly difficult to produce sufficient food to meet the needs of their people. Explanations for this situation include environmental causes such as drought and climatic change; political ones such as warfare and government indifference to rural development; the political-economic consequences of the disruption of rural production systems by integration into the world economy; and social changes such as population growth.

The relative importance of each of the above differs from case to case, but there is an emerging consensus that no one cause explains the recurrent deficits. Rather, they emerge from complex interaction among a set of social, economic, political, and environmental variables operating at local, national, and global scales over a long time period.

Policy makers have paid relatively little attention to local level, village-based strategies for coping with food deficits. It is at the village scale that most food is produced and at which the majority of the population seeks security in food production. When hunger threatens, it tends to begin in villages that are the most vulnerable; and if causal conditions prevail, it spreads over an increasingly large area. National and international concern is seldom expressed until widespread problems exist, by which time the villages initially affected may be in dire straits. It is now recognised that in the time between the emergence of a problem and appeals for external institutional assistance, people in affected communities employ a wide array of strategies to mitigate the emerging food shortage. In many cases these are sufficient to prevent a crisis, but in others they are eventually overwhelmed and severe food shortages ensue.

This paper reviews the literature on strategies for coping with food shortages in rural Africa and examines the available data on coping strategies used in the SADCC countries. Theoretical approaches to analysis of coping behaviour are compared, coping strategies are described and the

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structure of the coping behaviour discussed. This paper sets out the context for research being conducted by the authors into the nature of strategies for coping with recurrent food shortage in rural areas of Zimbabwe. This research is funded by the Ford Foundation, the University of Zimbabwe, Michigan State University, and the United States Information Service.

THE THEORETICAL CONTEXT

It is accepted that strategies for coping with recurrent food shortage are integral to rural socioeconomic systems. They include activities which may appear insignificant in years of plenty, but assume great importance during years of scarcity. They represent adjustments which societies have made--either in their socioeconomic and political systems or in their interaction with their environment--to reduce the risks of food shortage, most of which are associated with environmental hazards such as drought and insect damage.

Environmental approach

In recent years, scholars have addressed the relationship between society and the environment through three contrasting approaches. The earliest of these, environmental determinism, argued that the physical environment determines the nature of rural production. While popular for a few decades prior to World War II, and factual evidence did not support this approach. It is now seen as an apologia for colonial activities, rather than a scientific analysis. The demise of environmental determinism led to a neglect of analysing the role of the physical environment in explaining patterns of development.

Cultural ecology approach

During the 1950s and 1960s, most concern with the environment focussed on devising policies to reduce soil erosion and overgrazing. Environmental issues were seen as distinct, rather than as integral components of the rural socioeconomic system. Geographers and anthropologists continued to explore the interactive nature of people--environment relations within a cultural ecology framework. Cultural ecologists drew analogues with the concepts of adaptation and evolution in biology to argue that societies adapted themselves and their physical environment to try to meet the community's material and spiritual needs. The approach argued that societies faced with reoccurring food shortages would develop means to cope with their effects. Many researchers have examined indigenous strategies for coping with food shortage within this framework (Colson, 1979; Hankins, 1974; Tobert, 1985).

The adaptationist's cultural ecology approach is criticised for failing to recognise that the opportunity set of coping strategies is determined not only by the interaction of society with its physical environment, but also by both the structure of relations within the society and between local communities and the broader national socio-political structure.

Political ecology approach

An alternative approach known as political ecology (Bargatzky, 1984; Blaikie and Brookfield, 1987) developed out of a realisation that the adaptationist framework failed to explain recent food shortages in Africa. Rather, it recognised that integration of village communities into colonial economic systems had radically transformed the operational context of the interaction between village society and its environment. Consequently, the pre-existing adaptations were less effective in dealing with food shortage and the people were more vulnerable when environmental disruptions to food production began in the late 1960s (Wisner, 1977; Watts, 1983a; 1983b).

While the political ecology approach, centered in the dependency paradigm, has proven instructive in analysing the contemporary food security situation in Africa, it fails to explain circumstances where integration in colonial systems has reduced deaths due to the availability of marketed grain and food relief (Kates *et al.*, 1981) and it fails to explain shortages in socialist countries such as China (Torry, 1984; 1986).

Proposed framework

This paper proposes a more general conceptual model which incorporates the importance of both cultural ecology and political ecology, but strives for a greater range of applicability. The structure of rural systems is seen as emerging over time from an interaction between social, political and economic systems and their environment. Prior to the colonial period, African rural societies represented relatively closed systems in which the pattern of rural life was determined largely by village-level processes. As integration with the broader economy progressed, rural systems have become more open and determinants of the system's configuration have become increasingly distant from the village. Centralised, often sectoral, decision making in both socialist and capitalist countries has preempted local processes. This emphasis on sectoral matters has replaced the traditional focus upon the system as a whole and weakened the ability of local societies to manage their interaction with the physical environment (Berry *et al.*, 1977; Campbell, 1984).

In this context, village-coping strategies represent a subset of the total interaction between society and the physical environment. They have emerged as an integral part of the rural system and are subject to change as the development context of the village changes. However, they remain as vital mechanisms for ensuring the ability of rural communities to weather periods of food shortage.

STRATEGIES FOR COPING WITH FOOD SHORTAGE IN RURAL AFRICA

Numerous studies have documented strategies used by herding and farming communities in Sub-Saharan Africa to cope with food deficits[2]. They have shown that coping strategies are widespread; vary from one society to another; and are adopted in an identifiable sequence--most palatable are taken first and those representing major disruptions of societal norms are taken last.

In a review of societal responses to natural hazards, Burton, Kates and White (1978) have categorized coping strategies as reflecting means of preventing and modifying the hazard events, and of sharing and bearing the consequences. The strategies are based in the totality of the societies' economic, social, political, and environmental resources (Figure 1) reflecting their role as integral components of the system. Their importance in the system are often only apparent in times of deficit. In years of adequate production, they are often unimportant aspects of the production system. As such, they are vulnerable to disruption if development policies are implemented which fail to recognise the "occasional" significance of such strategies.

Economic strategies

Economic strategies for ameliorating the impact of events which reduce food availability include diversification of crops produced, animals owned, and on- and off-farm income supplements. Diversity reduces the risk of shortage as a downturn in one activity is offset to some extent by the continued production of others. It also allows for the flexible allocation of resources, such as labour, in response to changing circumstances.

A further set of economic strategies is based on savings. Farmers and herders build up stores of grain, livestock, cash, jewellery, and other commodities which are liquidated in times of difficulty, either through consumption or sale. In some cases, under conditions of severe hardship, people even sell productive assets such as draught animals and land and may abandon agriculture entirely.

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[2]For a review of such studies see Campbell (1986).

Figure 1. Characteristics of strategies for coping with food deficit.

	Social	Economic	Environmental	Political
Prevent occurrence of deficit	Extended family; Village ties; Clans etc.	Store, Production strategy; Economic diversity; Build up assets	Fallow; Manure; Ecological variety; Wild food	
Modify conditions of deficit	Pray; Pay rainmaker	Sell:crops, food,assets, livestock. Labour migration	Migrate to new lands	
Share consequences	Gifts; Loans; Children go to kin	Gifts; Loans		Access to relief institutions
Bear consequences	Pray; Elderly "go out to die"	Cattle die, Crops wilt		

Source: Modified from Burton, Kates and White (1978).

In recent years, as rural systems have become more fully integrated into national economies, extra-village strategies developed. For example, trading systems have allowed households to make cash purchase of grain over wide areas, and labour migration has assumed a greater role in reducing shortage.

Social strategies

Social responses to food shortage are found in reciprocal arrangements based on membership in institutions such as family, clan, and age set. Such institutions have fundamental roles in the organisation of society, among which is their coping function.

Social strategies include labour sharing (e.g. to tend a field or care for animals); the gift or loan of food, livestock or cash; and in some cases sending members of a distressed family to live with more fortunate relatives or friends. Such strategies are reciprocal in that assistance given at any one time may represent repayment of past kindness; or a commitment on the part of those being helped to assist the help-givers, should they experience problems at a future time. The pattern of reciprocity is complex across institutions and over time; assistance may even be repaid across generational boundaries (Cashdan, 1985).

Environmental strategies

Communities selectively use their physical resources base to reduce the likelihood of food shortage. Different locales, valleys, and hills provide different ecological potential which permit farmers to diversify crop production and allow herders to move their animals from one area to another in response to the availability of pasture and water. Fallow and uncultivated land offer resources such as wild fruit, berries, roots, and wildlife which supplement the food supply. While these may be used under good conditions, for example as food flavourings, there is substantial evidence that a range of "famine foods" are resorted to in quantity only during food shortages.

Political conditions

The political structure of rural society plays an important role in determining the access of people to resources (Sen, 1981). For example, in hierarchically organised societies scarce resources may be progressively denied to lower classes as a shortage intensifies. Studies of food shortage show that the poor suffer more and face shortages before the wealthy.

As village societies have become more dependent on exogenous supplies of food from national or international relief agencies, so the political relationships between and within countries have come to influence food availability. Urban areas receive food before rural ones; and rural areas with political influence are more likely to receive assistance than those occupied by minority or politically dissident groups. At the international level, the political orientation of a nation requesting help may influence the willingness of some donors to respond.

While the response categories are similar among different groups in a variety of countries, they may adopt different coping strategies. The nature of the production system, the environmental circumstances, and the history of the community will determine the specific response set.

Sequential adoption of coping strategies

A major finding of studies of societies confronting food shortage is that the available coping strategies are resorted to in an identifiable sequence. The sequence is a response to worsening conditions and reflects a move from strategies which can be easily used, with relatively little disruption to the socioeconomic system, towards those which represent a more radical departure from day-to-day patterns.

Watts (1983b) has conceptualised this sequence in terms of the increasing allocation of family resources and the reversibility of the actions taken. He argues that, in the initial phases of difficulty, available resources such as savings, labour, and wild foods are used by families. As the situation intensifies, recourse is sought in broader social and economic interactions such as loans and gifts from the extended family, sale of small stock, and male labour migration. Finally, sale of productive assets such as land and implements may occur and, as this reduces the capacity of the family to reestablish itself after the shortage is over, emigration, representing abandonment of agriculture, occurs.

Most studies have provided information on coping strategies and their sequence of adoption, but few have examined differences in the use of coping strategies among different groups of villagers, poor versus wealthy, young versus old, and men versus women. The evidence is scattered, but it suggests that there may be a gender, age, and economic class differentiation in the recourse to coping strategies.

Many studies have concluded that poorer families enter and move along the sequence of strategies ahead of wealthier ones (Campbell, 1977; Apeldoorn, 1981; Watts, 1983b; Hogg, 1985). Further, women may be more responsible than men for guiding the family through the early stages of shortage while men become more involved as the situation intensifies (Apeldoorn, 1981; Campbell and Trechter, 1982). This gender differentiation may be a fairly recent phenomenon as there is evidence that prior to the widespread practice of labour migration, men were involved in provisioning the family at all times.

Changing patterns in the structure of coping

The foregoing discussion has detailed examples of coping strategies and indicated that people structure the choice of strategy in such a way that a sequence of use exists. There is some evidence that the use of strategies in a community may vary according to economic status, gender, and age, and that within a country not all communities will have the same opportunities for coping due to differences in socioeconomic, political, and environmental circumstances. Further research is needed to examine these variations within the recognised general pattern of coping behaviour.

The pattern of coping is not static. Research has shown that strategies for mitigating food shortages are integral components of rural systems and will thus change as the rural system develops. The adaptationist approach argues that rural societies learned coping strategies over a long time period which promoted the long-term viability of the community. Prior to colonial intervention, rural systems were relatively closed and changed gradually, allowing time for successful adaptive change in coping strategies.

However, colonialism represented a swift and radical change. Rural systems rapidly opened up and had to adjust quickly to meet exigent demands for taxes, labour, and cash crops from a powerful exogenous force. Other colonial innovations such as education and medical care had their impacts over a longer period, but the cumulative effect was that all aspects of the rural system--economic, social, political, and environmental--had to simultaneously absorb disruptions. Rural systems were thrust into a state of rapid and continuous change as they adjusted to the imposed economic and political milieu.

These rapid changes occurred in response to the opportunities and constraints of the new order. The day-to-day workings of rural systems were in a state of flux; and as they adjusted to immediate conditions, attention to long-term, risk-reducing mechanisms tended to be reduced.

The altered configuration of the system of interaction between society and the environment often reduced opportunities for traditional coping strategies and new ones were sought to accommodate the broader system.

For example, social systems moved towards individual rather than communal structures, reducing attention to reciprocal coping arrangements. Population growth and the declining access to land as a result of European settlement increased land pressure in existing farming areas and pushed cultivation into more marginal bushland. With a reduction in the fallow period, yields declined and with less fallow and bushland, the availability of wild foods and game as diet supplements declined. The demand for food from urban markets and the non-agricultural labour force encouraged commercial sales at the expense of storage. Such sales, labour migration and expanded cash cropping represented a response to the expansion of the cash economy stimulated by the need to pay taxes and purchase goods in the cash sector. Therefore, a variety of long-standing coping strategies were undermined.

However, other coping strategies became available within the expanded economy. For example, cash obtained from labour migration and food and cash crop sales was available to purchase marketed food during times of scarcity. Further, the urban market for livestock increased the possibility of livestock sales. Increasingly, famine relief from governments and NGOs is seen as an expected source of assistance.

The lack of locally-based strategies is particularly important among recent settlers in areas where food deficits are recurrent. Such people--squatters, rural migrants, and settlement scheme residents--may not have had time to develop a system of interaction with the physical environment which incorporates coping mechanisms; and their relocation has often severed supportive social and political relationships. In the early years of settlement, they are particularly vulnerable. In such circumstances, a strategy needs to be developed which allows for external assistance to be given and simultaneously encourages settlers to search for coping mechanisms based on local resources.

Currently, villagers resort to a number of both well established and recently adopted strategies for coping with food deficits. There is some evidence that village-based strategies are being replaced by those which depend on the broader system, particularly among younger people whose greater exposure to the cash economy and to education has raised expectations of opportunity in the modern sector (Campbell, 1984). If this trend continues and becomes more widespread, the knowledge of coping strategies founded in the rural system may rapidly become eroded and result in increased dependence on external sources of assistance.

COPING STRATEGIES IN SADCC COUNTRIES

The problem of food shortage has a long history in the SADCC region (Gibson, 1977; Dias, 1981; Miller, 1982). While coping strategies used in the region have been studied less extensively than in Kenya, North East Africa, and West Africa, studies to date (Scudder, 1971; Devitt, 1978; Hitchcock, 1978; Colson, 1979; Cheater and Bourdillon, 1982, Vaughan, 1985) indicate that, while they may differ in detail, coping strategies in the region are similar to those found elsewhere in Africa.

Food shortages in Southern Africa manifest themselves at different levels --the subcontinental, national, regional, and local. At the subcontinental and national scales, they are most commonly associated with low and erratic rainfall; at the regional scale patchy rainfall, insect damage or crop disease may be the cause; and at the local level, scarcity may affect whole communities or individual families as a result of various socioeconomic conditions. For example, food shortages affecting much of the SADCC region occurred during the droughts of the late 1940s, early 1970s, and most recently in the early 1980s. The example of Zimbabwe illustrates the greater frequency of difficulty at the national and regional scales. Severe nationwide shortages associated with drought were reported in 1923-24, 1941-42, 1946-47, 1963-64, 1967-68, 1972-73, 1978-79 and 1981-84. Furthermore, in 1914, 1926-28, and 1945-46 the drier southern and western parts of the country were particularly affected--while the rest of the country obtained reasonable yields.

Prior to the colonial period, most activities designed to offset the impact of food shortage were based in the resources of local communities (Beach, 1977). Many of these activities remain in place today. Others have fallen into disuse and new coping strategies have emerged as rural systems have been incorporated into the broader regional and national sphere[3].

It is likely that localised food shortages occur somewhere in the SADCC region every year and these often affect only certain segments of the rural community. Those most vulnerable include poorer households and those that are socially or physically isolated from local or national centres of economic or political power. Such shortages may not necessarily arise from drought. Other factors in the social, political and economic milieu are often more critical than low rainfall. These factors which determine the supply and distribution of food and, hence, the persistence of shortage include:

- Inadequate amount or maldistribution of agricultural land can reduce the total amount and variety of food available to disadvantaged families.
- Poorer families, without cattle to provide draught power, particularly for ploughing, are unable to plant their crops at the onset of the rains and are thereby likely to suffer losses associated with late planting (the peak demand for draught power coincides with the end of the long dry season when the few cattle available are at their weakest and unable to work continuously in the fields).
- Domestic crises such as illness and death, particularly if it involves the head of household or the wife, can drastically reduce the family's food supply for the following season because they frequently involve increased demand on food reserves (for example, to feed mourners, as

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[3]This discussion is based on available academic studies, historical records and informal interviews conducted by the authors.

well as the temporary, or even permanent, reduction of labour allocated to crop production).

- Lack of access to and failure to use modern crop production techniques that improve yields; including animal manure, chemical fertilisers or hybrid seeds.

Where these localised conditions are exacerbated by low rainfall, insect damage, war or economic disruption; then the potential for extremely severe conditions exists.

Traditional village level coping strategies

Studies of coping strategies conducted in the SADCC region confirm the general findings for rural Africa as a whole. Studies in Tanzania (Hankins, 1974; Heijnen and Kates, 1974), Botswana (Kgathi and Opschoor, 1981), Zambia (Scudder, 1971; Colson, 1979) and Zimbabwe (Beach, 1977; Cheater and Bourdillon, 1982; Bratton, 1987) have shown that rural societies incorporate a variety of coping strategies. The contemporary pattern is different from that in the past as many traditional coping strategies have been undermined or modified by the impact of colonialism; land alienation for European settlement and the resultant redistribution of the indigenous population in increasingly overcrowded reserves; the introduction of the cash economy; and changing socioeconomic values (Zinyama, 1986; Zinyama and Whitlow, 1986).

The coping strategies which arise from the interaction of rural society and its environment and are integral to rural systems, assume greater significance during times of acute food shortages. As many different peoples live in the SADCC region, variations in coping strategies exist in the region --both within and between countries.

Figure 2 summarises the range of strategies that may be adopted by households threatened by an imminent food crisis. People turn to a variety of coping mechanisms available within the environmental, economic, and social milieu to enable them to cope with the food shortage. These are usually adopted sequentially as the severity of the crisis deepens. However, families practice a number of interdependent strategies at any one time.

Socio-cultural strategies

As discussed earlier, the extended family and tribal system has traditionally played a crucial role in reducing the impact of food shortages. For instance, within an extended family, more fortunate members may share their supplies with less fortunate relatives. Children may be sent to live with

Figure 2. Traditional household coping strategies in the SADCC region.

Environmental	Economic	Social
Ecological diversity - vlei and streambank cultivation	Trade	Extended family links (borrow food)
	Crafts	Pray to rainmakers
	Beer brewing	
Gathering of wild fruits	Sale of livestock and household effects	Raiding
Hunting and fishing		Sharing
Control of access to water and pasture	Growing of drought resistant crops (e.g.water melons)	Reduce meals
		Splitting herds[a]
Mobility[a]	Store food (grain and tubers such as sweet potatoes)	Arranged marriages
		Begging
	Migration	
		Stealing

[a]Strategy peculiar to herders.
Source: Adapted from Kgathi and Opschoor(1983), Cheater and Bourdillon (1982) and Campbell(1986).

grandparents or other relatives until the crisis is over (Hankins, 1974; Heijnen and Kates, 1974). Where those children are not welcome, they may resort to playing around the homes of more prosperous families in the hope that they will be invited to eat[4]. This practice takes advantage of the traditional hospitality code that one does not deny food to a person who is present at meal times.

Mechanisms for sharing food appear to function effectively while some community members continue to have adequate supplies. However, some evidence suggests that it may break down as scarcity becomes universal and patterns of food preparation and consumption alter significantly. Colson (1979) working among the Gwembe Tonga of Zambia, observed a sequence of changes in people's food preparation and consumption habits (Figure 3). As the crisis deepened, there was a shift from preferred to less-liked foods. Further, stones for grinding grain were moved indoors, together with other food preparation activities, to restrict knowledge about a family's food status to immediate family members. The next stage in the sequence was marked by a reduction in the number of meals and in the quantity of food served at each meal. Similarly, Kgathi and Opschoor (1981) reported that households reduced the number of meals eaten.

Other strategies based in the social system include the practice whereby a family confronting a severe shortage arranges a marriage for a daughter, often a very young one, at some future date into a wealthy family in return for food; and undesirable, socially degrading activities such as begging and stealing from granaries or standing crops. Raiding of weaker communities by stronger ones was a means of acquiring food in the past, but colonisation and the introduction of European administrative structures brought it to an end by the late nineteenth century. In some areas, in the past, family members were sold into slavery in exchange for food (Dias, 1981; Miller, 1982). A less tangible strategy lies in the use of prayer and rainmakers (Larson, 1966).

There is some evidence that the role of the extended family as a source of support may be weakening. For example, Bratton (1987), in a study of a number of areas in Zimbabwe, found that the importance of the extended family as a source of help during the drought years of the 1980s had diminished and that other social structures, such as farmers' organizations, had assumed a more prominent role in its stead.

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[4]This practice is known in Shona as *kukwata* and in Ndebele as *ukukwata*.

Figure 3. Sequential adoption of coping strategies among the Gwembe Tonga of Zambia.

Severity of food shortage

- Disintegration of villages and families
- Stealing/raiding
- Trade for food, sell meat, baskets, pots, mats
- Families no longer eat in the open (meal sharing ceases)
- Reduction of number of meals and food quantity
- Grindstones moved indoors and so are food preparation activities
- Change in food preparation and conservation techniques
- Shift in food preference

Time →

Source: Adapted from Colson (1979).

Economic strategies

As food shortages intensify, households adopt a variety of economic strategies to alleviate the crisis. Studies by Scudder (1971) among the Tonga and Bemba of Zambia, by Kgathi and Opschoor (1981) in Botswana, and by Cheater and Bourdillon (1982) in southern Zimbabwe, have shown that these include brewing beer for sale, selling craftwork, petty trading, hunting, fishing, gathering wild foods, the liquidation of savings, and the sale of livestock. Poorer families trade livestock, baskets, pots, etc. with wealthier ones for food, and brewing of beer using wild fruit and plants replaces the traditional beer brewed from sorghum or millet. In recent times migration to towns or to harvest cash crops such as cotton, have become increasingly important alternatives, though rural-to-rural migration is, in some areas, a long-standing response to food shortage (Dias, 1981).

Environmental strategies

Individuals usually gather wild fruits, fish and hunt in both good and bad years (Fleuret, 1979; Malaisse and Parent, 1985; Ogle and Grivetti, 1985), but they assume greater importance during food shortages (Campbell, A., 1986; Gibson, 1977; Kinsey, 1986). Scudder (1971) identified certain fruits which he classified as famine foods (e.g., fruits that are less palatable and are only utilised during food shortages). He also noted that the intensity of fruit gathering and the types of fruits changed as the food shortage worsened. For instance, when faced with critical shortages, the Tonga gather *Acacia albida* pods which are ordinarily poisonous to human beings. They render the seeds palatable and non-poisonous through an elaborate and time-consuming preparation process. In Zimbabwe, fruits normally eaten only as snacks between meals are often processed and dried for later use in order to extend declining grain reserves. The availability of such famine foods is declining due to changing land use patterns, particularly the extension of cultivation into formerly uncultivated areas and the reduction of the area under fallow (Brokensha and Riley, 1986) and their use is declining as knowledge of them is increasingly failed to be passed on from one generation to another (Malaisse and Parent, 1985).

Another environmental strategy for coping with food shortages is the establishment of small gardens in vlei areas and along streambanks (Hankins, 1974; Lambert *et al.*, 1987). These small gardens can supply the family with a family with a variety of vegetables for domestic consumption and for sale in order to obtain cash and/or grain. The availability of soil moisture or irrigation water from a nearby stream also enables the family to plant early-season grain crops such as maize which will be eaten as green mealies well before the main field crops are harvested. Therefore, these gardens provide a useful cushion against food shortage, particularly during the annual hungry season.

Recent changes in coping strategies

The above discussion has indicated that individuals resort to a variety of strategies in times of food deficit. Some are long-standing ones while others, such as labour migration, are more recent.

Impact of colonialization

Colonisation altered the practice of coping throughout the sub-region. In settler colonies, where plantations were extensive and where cash crop production was encouraged, major changes in agricultural production and land use occurred among indigenous peoples (Floyd, 1959). These changes altered the integration between society and the environment on which rural systems were founded.

Throughout the region, labour migration had a profound effect upon traditional patterns of production and upon the availability of labour to apply to coping strategies. The importance of male labour to the rural society is illustrated by the report of the Chief Native Commissioner for Mashonaland during 1903-04 drought. He explained the surprising lack of labour migration by the fact that men "considered it necessary to remain at home and dig roots, hunt, fish, and gather wild fruit for their families" (Southern Rhodesia, 1904, p.2).

The above quotation illustrates the remarkable awareness of food shortage and traditional responses which are reported in many early colonial reports in Southern Rhodesia[5]. Rather than promote the existing and recognised strategies, the government's emphasis on changing African agriculture often undermined them. Labour migration and cotton and maize production were encouraged within the colonial economy, despite the fact that the supportive nature of traditional agriculture--based on diversified crop production--was recognised. Increasingly, the government found itself responsible for providing food relief, much of which was distributed to markets and purchased with the proceeds of cash cropping or labour migration.

Government intervention

Government action to reduce the effects of food shortage is recorded as early as 1902-03 when grain was brought to markets and distributed free where starvation threatened (Southern Rhodesia, 1903). From the early 1930s, government actions were coordinated through the Grain Marketing Board (GMB) which moved large amounts of grain to deficit areas where it was sold by government agents, traders or less frequently, distributed free or in food-for-work programmes.

Where crop failure was widespread or successive harvest failures had depleted national food stocks, the GMB imported maize and other grains for distribution and sale. For example, it imported 178,900 mt of maize following the failure of the 1946-47 crop and 143,500 mt after the 1950-51 drought. More recently, some 268,900 mt of maize were imported during 1984 when stocks accumulated from the bumper harvest of 1980-81 had been depleted during successive drought years.

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[5]The subsequent discussion relates to Zimbabwe as the authors have not examined the historical record in other SADCC countries.

Apart from imports and large-scale internal grain transfers, additional government responses to national food shortages have included restrictions on the use of white maize in stockfeed, and requiring millers to blend whit emaize with yellow maize for human consumption--although the resulting product has been unpopular and withdrawn from the market at the earliest possible opportunity.

Government intervention to forestall food crises has been frequent and has become an expected source of support. The fact that cash purchases of food and government relief had come to replace many traditional strategies was recognised as a problem as early as the mid-1930s. Government reports spoke of the need to promote cash earning activities so that food could be bought in time of crop failure, as well as to pay taxes (Southern Rhodesia, 1935) and also that "the saying had become common: 'why worry? the Government will feed us'" (Southern Rhodesia, 1933, p.3).

In the contemporary context, food security is of major concern in the region and governments are involved in effective, but costly, interventions to reduce the incidence of severe hardship. While much attention is paid to providing external relief, there has been little investigation of locally available mechanisms for reducing food shortage, as the paucity of specific references in this paper indicates.

One of the objectives of the research the authors are conducting is to document local-level strategies for coping with food shortage in Zimbabwe. Existing strategies will be analysed to see if variations occur in the sequence of adoption, according to characteristics of the population such as economic status, gender, and age. Finally, the utility of these variations in formulating a system for monitoring village-level food security will be assessed.

CONCLUSION

Studies of coping strategies at the village level in the SADCC region suggest that the patterns of coping with food shortage in rural Southern Africa are similar to those found elsewhere on the continent and represent both continuity and change in traditional strategies. Some long-standing strategies are no longer in use, others are still employed, and new ones have evolved in response to recent socio-economic changes.

Throughout Africa, long-standing locally adapted strategies have disappeared or grown less effective, and are being replaced with redistribution strategies that depend on external institutions beyond the control of the village. If research shows that the SADCC region mirrors this general trend, the situation should be viewed with concern. Food shortages occur frequently in individual villages, but relief agencies usually become involved only when widespread deficits exist. Thus, if the shortages are scattered, exogenous-based relief may fail to respond to local needs. Consequently, in the absence of effective local strategies, local problems will become severe. Research has shown that widespread shortages arise from the accumulation of problems in individual villages. Those most vulnerable will suffer severe shortages before a widespread problem exists. By the time relief measures are implemented, those initially affected will be suffering greatly. Therefore, the external system is less sensitive to local conditions than that based on village resources.

Dependence upon exogenous, rather than local institutions, implies not only greater uncertainty as suggested above, but also greater cost to national governments. Local strategies are essentially free, in the sense that they represent calls on insurance mechanisms for which the premiums are paid continuously within the rural people--environment system. External relief involves the costly allocation of scarce funds which are diverted from development activities which might otherwise reduce the incidence of shortages in the long term. It would behove governments to maintain local coping strategies, rather than allow them to be undermined by increasing reliance upon external relief sources or by rural development plans which fail to consider them.

There is a need to also consider the reliability of external assistance. The political and economic conditions prevailing in an affected nation--and its relationships with donor nations and agencies--may affect the availability of relief and its distribution. Where economic problems, political will, civil strife, poor transportation facilities, shortage of fuel, and other such factors are likely to undermine the effectiveness of external agencies in acquiring and distributing food; then the consequences of reduced effectiveness of local coping strategies may be disastrous (Roape, 1979; 1985).

Therefore, there is a need to find a balance between local and external means for coping with food deficits. The reality of rural Africa is such that open systems have replaced more closed ones. Governments should recognize the opportunities of the exogenous system, but view with caution the tendency for them to supersede tested and locally relevant strategies. Development efforts must strive to obviate the need for frequent calls for famine relief; such relief should be a palliative, rather than an institutionalised component of development. One means for reducing the recourse to external relief is to incorporate within rural development programmes the objective of strengthening existing viable coping strategies and/or encouraging the search for new ones as the rural economy develops.

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THE STATE OF THE ART OF SORGHUM RESEARCH FOR COMMUNAL FARMERS IN ZIMBABWE

J.N. Mushonga[1]

INTRODUCTION

Sorghum *(Sorghum bicolor (L) Moench)* is a traditional food crop in Zimbabwe. It is generally grown in low-rainfall areas, particularly in Natural Regions III-V (Vincent and Thomas, 1960) which includes nearly 75% of the communal areas (Mugabe and Taguta, 1985).

These areas have great genetic diversity. Phenotypic variability is greatest in the southeast in Natural Regions IV and V. Matabeleland has the greatest diversity of landraces (Mushonga and Appa Rao, 1987) which probably explains why more sorghum is grown in Matabeleland communal areas than elsewhere. However, previous research has shown that the most profitable yields are obtained on heavy soils (Cackett, 1960). Sorghum yield data, compiled by the Central Statistics Office (1985) for the past five years, showed an average yield of 0.34 mt/ha for peasant farmers, compared to 2.10 mt/ha for commercial farmers. The yield difference could be due to poorer soil, lower quality seed, or different cultural practices used by peasant farmers.

GERMPLASM COLLECTION AND EVALUATION

Collection

During the 1900s most sorghum germplasm used in the breeding programme was of foreign origin. This included materials from East Africa--particularly Uganda and a combination of Kenyan and Tanzanian genotypes. Some germplasm also came from Nigeria, South Africa, and the United States. Breeders have used these materials for some time to produce various genotypes suitable for both animal feed and opaque beer. These exotic genotypes were mostly brown and unsuitable for processing into human food. However, the realisation that local germplasm was eroding--due to the introduction of improved varieties and hybrids--resulted in an effort to build a strong genetic base. During April to August 1982, the International Board for Plant

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Genetic Resources (IBPGR), the Crop Breeding Institute (CBI) of the Department of Research and Specialist Services (DR&SS) and the International Crop Research Institute for Semi-Arid Tropics (ICRISAT) launched a germplasm collecting mission for major Zimbabwe crops, including sorghum (Appa Rao and Mengesha, 1982; Toll and Gwarazimba, 1983). A second collection mission was launched during 1985 in which 733 sorghum samples were collected from farmers' fields, 414 samples from the International Trade Fair[2], Bulawayo, and 319 samples from the Harare Agricultural Show[2] (Appa Rao *et al.*, 1986). Plant collectors made several trips to different parts of the country when the crop was adequately mature. The collected samples were numbered with the prefix TGR and AMM, indicating the abbreviations of the collectors' names from the two missions.

Sorghum races and intermediates

The collection exercise identifited five basic races (Kafir, Caudatums, Guinea Dura, and Bicolor) and several intermediates (mostly of Kafir, Caudatum and Guinea). The occurrence of all five basic races in Zimbabwe is probably due to its geographical location between Southern Africa and Western Africa, diverse agroclimatic conditions, and farmers' selection, as well as maintenance of different race types. A variety of agroclimatic conditions (Kay, 1986), differences in altitude, temperature, rainfall, and soil conditions are also responsible for the occurrence of all five races. The distribution of these races are as follows:

- o Kafir. This race originated in Southern Africa, which includes Zimbabwe (de Wet and Harlon, 1976). It is extensively distributed throughout the country, but genetic variability was more abundant in the south of the country in Regions IV and V.
- o Caudatums. This race is largely grown in Masvingo province, Matabeleland South, and Manicaland Provinces.
- o Guinea. Although this race originated in West Africa, it has secondary centres in Tanzania and Malawi. It is commonly grown in southern Zimbabwe.
- o Durra. The origin of this race is Ethiopia. However, some traces have been found in Zimbabwe germplasm.
- o Bicolor. This race has no particular area of concentration and is found throughout Zimbabwe. The sweet sorghums in the area come from this race.

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[2]Samples were taken from grain farmers brought in to display at the fair/show.

The most common intermediates are hybrids between Kafir, Caudatum, and Guinea. Farmers have played a major role creating these through growing different races adjacent to each other or mixtures of races.

The greatest diversity of landraces and their intermediates was observed in Matabeleland Province, but deceases as one moves to the north towards the Zambezi Valley (Mushonga and Appa Rao, 1987).

Evaluation

Sorghum was evaluated at the Variety Testing Centre (VTC) Gwebi, Panmure Experiment Station, and at Matopos Research Station; in collaboration with the SADCC/ICRISAT sorghum and millet improvement programme. To assess the full potential of the material, the germplasm was grown under good management conditions.

The genotypes were evaluated to determine the number of days from emergence to flower and physiological maturity. This is necessary to separate the early, intermediate and late-maturing types. Also the endosperm was characterised in terms of hardness (soft or hard) and by grain shape. Yield data were also collected to assess if some of the genotypes were useful for including in a crossing programme.

BREEDING PROGRAM

Objective

In the past, the main emphasis in the sorghum breeding programme was on developing of high-yielding genotypes. However, quality parameters and agronomic traits have recently generated tremendous interest in the programme. To develop elite materials suitable for these traits, breeders have initiated an elaborate programme using the pedigree breeding method, following the head-to-row approach. The objective in this case has been to develop populations which will eventually lead to hybridisation.

Population generations

The programme has generated a wide range of breeding materials by exploiting the diverse material from the germplasm collected during 1982 and 1985, respectively. Exotic germplasm was also utilised in this exercise through hand-emasculation and using the plastic method. This approach has produced over 300 segregating populations of differing generations. The populations are being selfed and advanced through generations to develop elite lines suitable for varieties and hybrid parents.

The programme is giving priority to selecting for white corneous endosperm grain which is suitable for diversified food products. In addition to white coloured grain, red and brown grain types are also being sought to meet other needs such as animal feed and malting for opaque beer.

Hybridisation

The planting of sorghum hybrids is on the increase in Zimbabwe. Both large- and small-scale commercial farmers are accustomed to growing hybrid sorghum. However, only a limited number of communal farmers grow hybrid sorghum due to the high cost of seed. Therefore, communal farmers more commonly grow open-pollinated varieties since the seed can be used for more than one season, a practice which cannot be followed with hybrid sorghum.

The elite lines which originated from germplasm collected have been very useful, both in the development of hybrids as well as a source of varieties that provides farmers with a wider choice of materials (Mushonga, 1983).

TESTING PROGRAMME

The testing programme has followed two stages, first on-station and then on-farm evaluation.

On-station testing

A number of hybrids and open-pollinated varieties have been tested on several research stations throughout the country. The experimental hybrids have out yielded the two commercial hybrids, DC 75 and DC 99. Two newly released open-pollinated white varieties (SV-1 and SV-2) were compared with these hybrids in preliminary variety trials at Gwebi and Kadoma Research stations in the 1982-83 season; and also assessed in intermediate variety trials at several research stations during the 1983-84 growing period. SV-1 and SV-2 performed well in both preliminary and intermediate trials. Further testing in advanced trial was conducted during the 1984-85 and 1985-86 seasons.

Averaged across all sites and years, DC 75 gave the highest yield (4.6 mt/ha), followed by DC 99 (4.1 mt/ha), SV-2 (3.3 mt/ha) and SV-1 (3.2 mt/ha) as shown in Table 1. Both DC 99 and DC 75 did well on most of the stations, except in 1985-86 at Panmure where both hybrids performed just under and slightly above 1 mt/ha, respectively. During the same season, the new varieties SV-1 and SV-2 averaged approximately double the yield of the hybrids. Yet overall, the hybrids outyielded the two varieties. DC 75 gave a 45% higher yield than SV-1 and a 41% higher yield than SV-2. This is to be expected due to hybrid vigour. Also, since management is better on research stations, both hybrids and varieties should perform better in on-station than in on-farm tests.

Table 1. Grain yield in advanced sorghum variety trial (mt/ha), 1984-85 to 1985-87, Zimbabwe.

		Variety				
Year	Site	DC75[a]	DC99[a]	SV-1[b]	SV-2[b]	C V[c]
1984-85	Gwebi	6.90	6.90	4.80	4.30	13.83
	Kadoma	5.50	4.90	4.70	4.60	13.03
	Panmure	6.90	7.80	6.90	6.10	10.95
	Matopos	5.20	4.50	2.70	4.30	37.16
	Rattray Arnold	2.10	2.20	2.20	2.30	11.91
	Makoholi	2.50	2.90	1.40	2.30	51.38
1985-86	Gwebi	7.28	6.70	2.54	3.12	12.70
	Kadoma	7.86	5.52	4.90	4.84	14.80
	Panmure	1.22	0.91	2.18	1.72	58.00
	Matopos	1.24	5.29	0.56	0.60	62.00
Variety Mean		4.62	4.09	3.16	3.28	

[a]Commercial hybrids;
[b]White open-pollinated varieties;
[c]Coefficient of variation (%)
Source: Plant Breeding Institute, DR&SS

On-farm testing

On-farm testing procedures were slightly different than thosed used on the research stations. The varieties compared were Red Swazi A, a widely grown open-pollinated variety, and the two new varieties, SV-1 and SV-2. The three varieties were evaluated during three consecutive seasons at several locations in Natural Regions II to IV. Unfortunately, trials at several sites were lost due to severe drought and poor seed establishment.

The recently released varieties, SV-1 and SV-2, slightly out-yielded Red Swazi A (Table 2). Also, their grain quality and plant type make them more desirable than Red Swazi A which has brown grain with a soft endosperm.

Important agronomic characteristics of sorghum include plant height, exertion, and seed size (Table 3). Plant height is an important varietal characteristic since the taller the crop, the more difficult it is to scare birds. Both SV-1 and SV-2 compare well to Red Swazi A in this respect. The exertion of both new varieties is within an acceptable range (Table 3).

The major advantages of SV-1 and SV-2 over Red Swazi A are white grain type, a hard endosperm, and the plant type. These grain characteristics contribute to high quality human food products.

GRAIN QUALITY EVALUATION

During the past several years, the sorghum improvement programme has concentrated on developing of red and brown grain types. The brown colour possesses a subcoat which contains tannins. Generally, these grains also contain soft endosperm which make them difficult to process. Most of the people in the rural area who use sorghum as a staple food depend on the traditional processing method, hand-pounding. However, a disadvantage of the traditional method is that it results in high grain loss through breaking --especially when using varieties like Red Swazi A, DC 99, and DC 75, due to their soft endosperm. Even if a mechanical dehuller is used, the grain recovery rate is lower than that obtained when dehulling hard endosperm, white grain types like SV-1 and SV-2.

To demonstrate the differences in dehulling quality between soft brown endosperm types and hard white endosperm grain; a small domestic-sized dehuller was developed. The dehuller was also intended to reduce the drudgery for women in dehulling sorghum grain, and thus encourage greater grain utilisation (Mushonga and Appa Rao, 1985). The dehuller consists of fine carborundum discs mounted on an axis connected to an electric motor. Dehulling is achieved by the abrasive action of the discs. Several brown and white were dehulled for 2-30 minutes. The results indicated a higher grain recovery rate for hard white endosperm varieties, compared to the soft

Table 2. Grain yield in communal areas (mt/ha) sorghum variety trial, 1984-85, Zimbabwe.

		Variety			
Year	Site	SV-1[a]	R.S.A[b]	SV-2[a]	C V[c]
1984-85	Wedza-Gunda	2.55	2.01	2.33	23.47
	Wedza-Manyadza	1.30	1.60	1.60	23.38
	Wedza-Magaba	3.10	2.00	2.50	26.74
	Mudzi-Kadyaukonde	1.20	1.30	2.00	46.13
	Suswe	4.00	2.40	4.40	25.49
	Mukumbura	2.80	2.60	1.50	40.30
	Rushinga-Machacha	3.50	2.60	3.60	22.19
	Matabeleland South	1.80	2.40	1.10	24.09
	Chilimanzi	2.10	1.90	1.60	35.05
1985-86	Wedza	1.08	1.28	0.92	38.00
	Wedza	2.40	2.27	2.25	27.80
	Mutoko	1.53	1.50	1.86	30.00
	Rushinga	1.21	0.72	1.27	28.15
	Wata	3.54	2.52	2.66	19.30
	Muzarabani	1.05	2.72	2.32	29.00
1986-87	Wedza	0.56	1.72	1.56	39.50
	Charter	0.67	0.89	1.00	39.70
	Mutoko	0.95	0.67	0.33	29.10
	Variety Mean	1.66	1.63	1.71	

[a]White open pollinated variety
bRed open-pollinated variety
[c]Coefficient of variation (%)
Source: Plant Breeding Institute, R&SS

Table 3. Plant characters over all communal trial area sites, 1984-85 to 1986-87, Zimbabwe.

		Variety		
Character[a]	No. of trials	SV-1	SV-2	RedSwazi A
Plant height (cm)	15	125.00	145.00	119.00
Exertion (cm)	15	5.33	12.54	9.05
1,000 seed wt (g)	15	18.57	20.41	20.44

[a]Mean overall sites.
Source: Plant Breeding Institute, R&SS.

brown types at the end of 30 minutes. This indicates that hard white endosperm grain has superior grain quality, compared to soft brown endosperm types.

A palatability test was also conducted on white and brown flour. Both white and brown sorghum flour was made into thick porridge and a taste panel evaluated it. The majority of the panelists preferred the porridge from the hard white endosperm grain to the porridge from the soft brown grain.

DISEASE AND PEST EVALUATION

Diseases

Several leaf and grain diseases have been identified and evaluated in most of the research stations and on-farm trials. For several varieties, leaf blight and ergot ranked 3 and 4 on a scale of 1 to 5 with a greater number denoting higher severity. Other diseases identified were sooty stripe, grey leaf spot, zonate leaf spot, anthracnose, and rust. Cooperation between pathologists and breeders has been launched to assess if these are of economic importance. Research has shown that Red Swazi A suffers much more from leaf blight and ergot than SV-1 and SV-2.

Pests

The pests of economic importance are stalkborer, aphids and the American bollworm (Mushonga, 1982). Interestingly, aphid infestation is more common on both reasearch stations and commercial farms than in communal areas. Stalkborer is a serious sorghum pest. Research is under way to establish the level of susceptibility among varieties.

CONCLUSION

The sorghum research programme for the communal areas is concerned with developing high-yielding open pollinated varieties with good grain quality. We are also interested in developing elite lines from germplasm which is agronomically suitable for the communal farmer, with good disease and pest tolerance. There is also a need to develop early-maturing varieties, suitable for different regions, so that farmers will have a wide range of materials from which to choose.

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HOUSEHOLD FOOD INSECURITY IN LOW-RAINFALL AREAS OF ZIMBABWE: INITIAL FINDINGS IN MUDZI, MUTOKO AND BUHERA COMMUNAL AREAS

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INTRODUCTION

The drought years of 1981-82, 1982-83, 1983-84 and 1986-87 have highlighted the problem of food insecurity for households in the low-rainfall areas of Zimbabwe. These areas, classified as Natural Regions III, IV, and V, encompass 91% of the communal lands and provide an economic base for approximately 55% of Zimbabwe's population--900,000 farm households (CSO, 1987).

Natural Regions III, IV, and V have infertile soil, low-rainfall (below 700 mm per annum), severe dry spells during the rainy season, and periodic seasonal droughts. Consequently, food and cash crop production are risky. Many households face chronic food insecurity year-after-year. Larger numbers experience transitory food insecurity following the frequent poor seasons.

Since 1980, drought has caused widespread crop failures. The majority of communal households have experienced reduced incomes and food shortages, requiring them to rely on food transfers from the government. Approximately 350,000 households have received government support through commodity food aid or food-for-work programmes. Since 1981-82, the government has spent an estimated Z$800 million on these programmes, excluding costs borne by non-governmental organisations (Mhiribidi, 1987). In addition, households themselves have been forced to divert remittances from production investment to consumption, dispose of production assets, and migrate in search of alternative income sources.

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A household is food secure when it is able to acquire--through transfers, production or purchase--food in qualities and quantities that meet the nutritional requirements of its members (Eicher and Staatz, 1984). Increased production of yield-stable food and cash crops will contribute towards improving household food security. Food crop production directly contributes to meeting food needs, while cash generated from crop sales gives purchasing power to households to acquire food sold in the market. Shortfalls in food production and purchasing power that threaten food security are, as a last resort, met through government transfer progrmmes.

As a long term solution, the government has advocated two strategies to improve the food security and incomes of households in the low-rainfall areas. First, the government is encouraging increased production of high value crops adapted to low rainfall areas to improve cash incomes such as oilseed crops (particularly sunflowers and groundnuts) and cotton.

Second, in the more drought-prone areas, government is encouraging the production of drought-tolerant food grains. Emphasis is on small grains--sorghum, pearl millet (*mhunga)*, and finger millet *(rapoko)* with the objective of reducing dependence on maize productions. Maize varieties currently available are highly susceptible to drought and mid-season dry spells.

This paper describes research in progress designed to analyse the nature of household food insecurity in low-rainfall areas, and the potential role of small grains and oilseeds in reducing household food insecurity. This paper develops the research issues to be examined in the study, drawing from both the results of a preliminary (rapid appraisal) survey conducted in the study areas--Buhera, Mudzi, and Mutoko Communal Lands--and presents preliminary analysis of secondary data on production, marketing, and interventions strategies currently in place in the three communal areas.

IMPORTANCE OF THE SMALL GRAINS AND OILSEEDS SUBSECTORS IN HOUSEHOLD FOOD SECURITY

Small grains and oilseeds are alternative crops for farmers in the low-rainfall areas that present an opportunity for increasing household food security and cash income. Important oilseeds in low-rainfall farming systems are sunflowers and groundnuts. Sunflowers are grown solely as a cash crop, but groundnuts are a household source of protein, edible oil, and cash.

At the national level, increased oilseed production would contribute toward reducing Zimbabwe's dependence on imported edible oils. Over the last five years, Zimbabwe has become a deficit producer of vegetable oils and fats. Oilseed production has declined in both the commercial and communal farm sectors, partly because oilseed prices declined relative to those for maize. Recently, the government has sought to stimulate production of oilseeds by reversing this relative price decline.

Small grains in Zimbabwe include sorghum, pearl millet, and finger millet. Small grains are important as alternative crops for the low-rainfall communal areas because they are drought tolerant, and are staple crops in these areas. In recent years, small grain production has declined as communal farmers adopted improved maize technologies which increased yields and net returns. Comparable improved technologies have not been available for small grains. In addition, farmers have shifted out of small grains production due to the high labour requirement of traditional home-processing methods and the absence of labour-saving processing techniques.

Nevertheless, Zimbabwe currently has a national surplus of small grains. To reduce this stock, government could reduce the producer price for small grains. Yet, this would make small grains even less profitable--thereby reinforcing the shift toward the production of crops such as maize which are less suited to low-rainfall regions. This would have a negative impact on household food security.

A major problem facing the small grain subsector is low utilisation. At the household level, small grain consumption is affected by the availability of maize substitutes, the lower net returns to small grains compared to maize production, high processing costs, and the lack of efficient processing technology. At the industrial level, the Grain Marketing Board's (GMB) selling price ratio between small grains and maize is often cited as the major constraint to increased utilisation. Government policy has concentrated on increasing supply through price incentives to the producer. Yet, the rise in small grain producer prices has placed a further constraint on industrial demand. The pursuit of improved income distribution through higher product prices conflicts with the objective of increasing small grain utilisation. Against this background, research is needed to identify appropriate institutional and price policies to improve producers' net returns, stimulate household demand, and promote industrial utilization.

RESEARCH SITE CHARACTERISTICS

Criteria for research sites selection

The study is sited in three communal lands located in three administrative districts in Natural Regions III, IV, and V. Mutoko District is in Natural Regions III and IV. Mudzi District, adjacent to Mutoko, is wholly in Region IV. Buhera District is divided, roughly equally, between Region III, Region IV, and Region V. The survey research component of the study covers six villages in Natural Region IV and six villages in Natural Region V, with a total of 300 households.

The main criterion for choosing the villages and households is that they be located in Regions IV and V where small grains and oilseeds are widely produced. As described earlier, Natural Regions IV and V are characterized by factors that make crop based farming systems very risky, including:

- o low rainfall (below 700 mm per annum) which is unevenly distributed throughout the season;
- o high temperatures, reducing the effectiveness of rainfall;
- o mid-season severe dry spells; and
- o seasonal droughts.

About 74% of Zimbabwe's communal area is in Natural Regions IV and V (65% of the whole country) and about 65% of the communal lands' population live there. Improving household food security in these areas presents a significant challenge not only for residents in these regions, but also for the whole country.

Natural Regions IV and V are ideal sites for research on oilseeds and small grains. About 66% of the country's small grain area is in communal lands in Regions IV and V, making these crops important sources of food and cash incomes for these households. Furthermore, oilseeds (sunflowers and groundnuts) are possible alternative cash crops, given that they do well in low-rainfall areas.

Demographic and household characteristics

The population densities of Buhera and Mutoko Districts, are above the national average of 22 persons per square kilometre (Table 1). In Buhera, the population is heavily concentrated in the northern and central parts which are in Natural Regions III and IV, respectively. Southern Buhera is wholly in Natural Region V and is sparsely populated (Zimbabwe Government, 1986). Northern Mudzi District is also sparcely populated, partly because of tsetse infestation. Yet, it is experiencing in-migration from other parts of Mashonaland East Province.

Up to 60% of male household heads reside outside Mutoko, performing wage employment, compared with around 30% in Buhera. Thus, remittances are an important income source in Mutoko. A substantial amount of the remittances are in-kind such as agricultural inputs.

In Mutoko District, nearly 98% of the arable land is cultivated, with an average holding of 3.67 ha per household. In sharp contrast, in Mudzi only about 25% of the arable land is cultivated. The average households plant 1.5 ha, although an average of 9.0 ha of arable land are available. This reflects both the sparse population distribution and farmers' inability to cultivate more land because of a draft animal shortage due to tsetse infestation.

Table 1. Characteristics of the household food security research study areas, Zimbabwe.

	Communal Area		
	Buhera	Mudzi[a]	Mutoko
Land area (000 ha)	557	487	149
Land in Natural Region (%):			
IIb			
III	30	0	35
IV	32	100	65
V	38	0	0
Average annual rainfall (mm)	600	650	677
Population (000 people):			
1969	74	31	74
1982	131	67	71
1987	165	73	107
Number of households in 1987 (000)	33	12	13
Population density (people/sq.km)	30	15	71
Household heads away (%)	30-40	40-50	50-60
Households with no land (%)	20-30	5	15-20
Land use in 1985-86 (000 ha):			
Maize	60	15	18
Groundnuts	10	2	3
Sorghum	5	2	1
Millets	130	22	15
Sunflowers	4	2	2
Vegetables	2	2	2
Cotton	0	0	1
Other	20	4	13

[a].Mudzi District includes four communal areas: Chikwizo, Ngarwe, Mukota and Mudzi

Source: Zimbabwe Government (1986).

Northern and central Buhera are under extreme land pressure with nearly 100% of the arable land cultivated. Arable land holdings average 3.0 ha per household (Zimbabwe Government, 1986). These demographic characteristics of Buhera and Mutoko suggest that there is pressure on the economic bases on which households depend for food security.

Cropping patterns

In Mutoko District, the major crops are maize, groundnuts, sunflowers, cotton, sorghum, pearl millet, and finger millets, although maize occupies the largest share of area planted. In Mudzi, farmers grow the same crops as in Mutoko, with cotton and sunflowers grown in pockets with heavy-textured red soils.

Throughout Buhera District, the prevalent crops are maize, groundnuts, pearl millet, sorghum, sunflowers, and finger millet. Small grains are predominantly grown in the south (Natural Region V) and are the dominant crop in terms of land allocation. Groundnuts and sunflowers are more widely grown in northern and central Buhera, while maize is grown throughout, although it is more suited to the north (Natural Region III).

Food preferences

The prevalence of maize and the large share of the land allocated to maize suggests that maize is the preferred grain in Mutoko, Mudzi, and north and central Buhera. However, it is difficult to ascertain household food preference as a number of factors come into play. Maize may be preferred above other grains because of its texture, colour, taste quality, and ease of home processing. Key informants reported that maize is the staple grain that is consumed following harvest. Small grains are stored in reserve and consumed when maize is in short supply. Also small grains can be stored for two to three years, compared with only one year for maize. In production deficient years, households prefer maize over small grains as food aid. Finally, it appears that the lack of a small grains processing technology contributes to the limited consumption of these grains, since home processing of small grains is very time consuming.

Production and marketing statistics

In Mutoko District, the major marketed crops are maize, pearl millet, sorghum, sunflowers, finger millet, and groundnuts. Mudzi's sales pattern is similar to that of Mutoko. In Buhera District, the major marketed crops are maize, sorghum, finger millet, pearl millet, sunflowers, and groundnuts (Table 2).

When deciding which crops to grow for sale, farmers appear to place pri-

Table 2. Crop sales to the GMB by communal area, 1976-77 to 1986-87, Zimbabwe (000 mt)[a].

GMB Intake Year	Buhera						Mudzi						Mutoko					
	Gn	Mz	PM	FM	Sor	Sf	Gn	Mz	PM	FM	Sor	Sf	Gn	Mz	PM	FM	Sor	Sf
1976-77	895	851	b	b	b	b	10	4	b	b	b	b	9	44	b	b	b	b
1977-78	643	986	b	b	127	b	4	6	b	b	22	b	<1	26	b	b	2	b
1978-79	2117	137	b	b	190	b	36	103	b	b	2	b	2	20	b	b	<1	b
1979-80	286	6	b	b	65	b	NA	NA	b	b	1	b	3	24	b	b	<1	b
1980-81	1107	581	b	b	213	b	17	1796	b	b	NA	b	NA	447	b	b	NA	b
1981-82	496	9244	b	b	128	b	91	3773	b	b	14	b	12	2862	b	b	26	b
1982-83	107	3800	b	b	174	b	142	7086	b	b	85	b	40	7319	b	b	50	b
1983-84	1	21	b	b	2	b	2	26	b	b	18	b	36	4102	b	b	10	b
1984-85	1	864	71	12	161	59	21	3931	69	4	115	133	10	390	24	<1	32	35
1985-86	31	6818	257	560	982	284	94	3035	753	98	544	346	32	6817	466	167	33	122
1986-87	249	4411	NA	<1	152	480	369	3300	457	171	197	529	142	6829	55	3	74	138

[a] Gn = groundnuts
Mz = maize
PM = pearl millet (munga)
FM = finger millet (rapoko)
Sor = sorghum
SF = sunflowers

[b] No GMB purchases, because this was not a controlled crop in this year.

Source: Grain Marketing Board, from data made available by J. Stanning, Department of Agricultural Economics and Extension, University of Zimbabwe.

ority on planting crops with favourable returns--preferred food crops--and crops with an assured market and price. Changes in groundnut and sunflower production and marketing have resulted from shifts in their relative profitability, relative prices, and marketing policies.

Sources of income

In all three study areas, households depend on marketed cash and food crop surpluses to generate most of their income. The GMB crop intake data indicates that in Mudzi and Mutoko, maize, sorghum, pearl millet, and oilseeds generate the most income. In Buhera, maize, sorghum, and pearl millet are the major cash income generators, respectively. In southern Buhera, cattle and goat sales are also important income sources.

Horticultural crops and fruits provide a sizeable proportion of household income in Mutoko and, to some extent, in Mudzi. Vegetables are grown intensively in wet lands (valleys, river banks, etc.) and are marketed mainly in Harare. Buhera has several irrigation schemes where horticultural production is the most profitable venture.

Remittances constitute a major source of household income in Mutoko. Up to 60% of male household heads engage in wage employment on surrounding commercial farms and in distant urban centres, particularly Harare. In Buhera, where up to 70% of household heads are resident, households have limited access to remittances. In addition, since there are no large-scale commercial farms near Buhera, households do not have an opportunity for farm-wage employment as in Mutoko and Mudzi.

Access to markets

In Mutoko District there is a GMB depot at Mutoko Growth Centre. In addition, several GMB approved buyers operate at the growth centre, one within metres of the GMB depot. About 35-40% of the Mutoko GMB's intake comes through approved buyers. Farmers prefer to market through approved buyers, partly because they are paid upon delivery of their produce. In contrast, the GMB credits the farmer and pays them two-to-three months later. The GMB may prefer farmers to deliver their grain through approved buyers so as to reduce the number of transactions it must conduct. There are two additional collection points in Mutoko, located 20-30 km from the growth point. In contrast, there is no GMB depot in Mudzi communal land, which is 70-90 km away from Mutoko Growth Centre. Therefore, farmers transport their produce directly to Mutoko. Cotton grown in Mutoko and Mudzi is marketed about 200 km away at Shamva because there is no Cotton Marketing Board depot in Mutoko. Mutoko and Mudzi are well serviced by input dealers who have established market outlets at Mutoko Growth Centre.

Buhera is a large district, about 200 km from north-to-south The GMB depot is at Buhera Growth Centre, about 150 km from our study area in southern Buhera. The main sources of inputs are in Harare, 223 km away, Rusape about 120 km away or Chivhu about 90 km away--which is poorly stocked with agricultural inputs. The southern part of the district is far from the major retail outlets which are located in the central and northern Buhera.

Improving household food security

Small grains are a major food source in the three communal lands, particularly in Buhera. Inferring from the GMB intake of small grains and oilseeds, these crops constitute a major source of cash income in the study areas.

However, several interventions are needed to enhance the role of small grains and oilseeds in meeting food security and cash needs. Yields are low and severely affected by intra and interseasonal rainfall variability. Therefore, stable and high-yielding varieties are needed. In general, farmers have not adopted recommended management practices. Hence, there is a need to better understand farmers' crop management strategies, reasons for not adopting recommended practices, and the economic viability of available technology under low-rainfall conditions. Particularly in southern Buhera, improved infrastructure may be required to provide farmers greater access to input and product markets.

Currently, there are limited opportunities for off-farm employment within the districts. Creation of alternative income-generating projects would contribute to a long term strategy for improving food security for households without adequate land or those experiencing seasonal food shortages.

HISTORY AND NATURE OF FOOD INSECURITY

History and extent of food insecurity

During the period 1980 to 1987, food insecurity has repeatedly threatened households in the study area. At least 70% of all households received government assistance following the 1986-87 drought (Table 3).

Yet, statistics on households participating in food transfer programmes may give a misleading picture of the magnitude of the food insecurity situation in each district for the following reasons:

- o Recipients of food transfers are selected by ward councillors after making a visual or "spy" assessment of their current production status. This assessment is open to discrepancies. Households with adequate food supplies from past production may be selected on the basis of their current poor performance. Also, it is possible that households

Table 3. Households receiving drought relief in Buhhera, Mudzi, and Mutoko Districts, 1987, Zimbabwe.

District	Total No. of households	Drought relief programme recipients				Total Costs (Z$ mill)
		Food Aid		Food-for-Work		
		No.	%	No.	%	
Buhera	32,762	15,000	46	10,000	31	4.3
Mudzi	12,760	10,000	78	NA	NA	NA
Mutoko	12,753	4,000	31	5,000	39	1.5

NA Indicates data not available
Source: District administration officials in Buhera, Mudzi, and Mutoko Districts.

with adequate production and food supplies may be selected due to their influence in the ward.

- o Households with one or more members of the family engaged in wage employment outside the village or ward are automatically disqualified from receiving food aid. However, not all such households receive adequate food transfers from relatives in wage employment. Furthermore, households generaly believe that they are entitled to food transfers, irrespective of having access to other means of support. Thus there is no water-tight mechanism for targeting aid to only the truly needy households.
- o Some households engaged in food-for-work are interested in the cash income to purchase other household requirements, not food. Such households may not need food support.
- o Councillors feel that they should share equally all the money earmarked for a district, so they inflate the number of households needing help. Councillors anxious to get their local development projects funded may also do the same to get a larger share of the food-for-work money.

For the above reasons, the actual food insecurity situation could be better or worse than the statistics show. However, no other data are available.

Nature and causes of food insecurity

While Table 3 highlights the incidence of transitory food insecurity caused by interseasonal rainfall variability, no information is available on the incidence and extent of chronic food insecurity in Buhera, Mudzi, and Mutoko districts. The existence and magnitude of chronic food insecurity could be inferred from indicators such as the extent of malnutrition in the population's vulnerable groups percent of households that are landless or without adequate land, and household consumption requirements as a percent of grain produced.

Vulnerability to both chronic and transitory food insecurity may arise from the failure of a household to produce enough grain to meet their needs (supply deficiency); inadequate cash income (purchasing power deficiencies); and the non-availability of food transfers (food transfer deficiencies), due to a number of interrelated factors (Figure 1).

The low crop yield and income levels, which are intrinsic to low-rainfall areas, coupled with inefficient or non-functioning labour and food markets, exacerbate food insecurity caused by interseasonal fluctuations in household food production. Furthermore, the exogenous and endogenous determinants of household food insecurity reinforce each other. Purchasing power deficiency is also a contributor to supply deficiency in that without adequate incomes, households are not in a position to purchase production inputs (e.g., draft power, fertilisers, agricultural labour) needed to increase productivity and output.

Current interventions to alleviate food insecurity

Interventions to alleviate food insecurity include direct relief, supplemental food production programmes, household coping strategies, and technological strategies.

<u>Drought relief</u>

The government's two drought relief programmes aimed at alleviating food insecurity in the short-run are:

- o Direct food aid. Free food is provided to households that have experienced crop failure and have no access to other means of support such as wage employment by any household member.

Figure 1. Factors contributing to food household insecurity

Rural economy	Nature of problem		Contributing Factor
			EXOGENOUS:
	SUPPLY DEFICIENCIES		<u>Technical</u>
PRODUCT MARKETS	o Food produced does not last all year	Low yields of cash and food crops	o Crop varieties o Cropping system o Soil type and fertility
o Inefficient o Non-functioning o Fluctuations in supply o High prices	o Food produced inadequate for family size		o Climatic conditions o Rainfall pattern
	o Large portion marketed with inadequate left for home use		<u>Institutional</u> o Extension coverage o Credit availability o Marketing infrastructure o Land tenure
EMPLOYMENT MARKETS o Few cash income opportunities o Inadequate remittances o High prices o Fluctuations in employment	PURCHASING POWER DEFICIENCY o Cash generated does not last all year	Intra- and inter-seasonal fluctuation in output and income	<u>Policy</u> o Price policy for inputs and outputs o Development strategies o Non-agricultural wage policies o Consumer price policy
	FOOD TRANSFER DEFICIENCY o Food-for-work o Food aid		ENDOGENOUS o Household composition o Food preferences o Resource endowment o Income levels and access to income

- o Public Works Project. Food-for-work is designed to increase the purchasing power of households, thereby enabling them to purchase food that is either locally available or made available from the government; and to improve rural infrastructure by employing individuals on rural development projects (e.g., school, dam and road construction, land conservation and/or reclamation, tree planting, water and sanitation projects, and other projects identified at both local and district levels).

A possible criticism of the current free food aid programme is that only maize is provided, even in areas where small grains are the historical staple crop. However, all the key informants interviewed reported that households prefer to receive maize over small grains. Participants in public works projects are selected from households identified as needing assistance (one person per household). They are paid Z$2 per person per day. Public works projects are better than free food distribution programmes because they avoid creating a dependency, screen households that may not find it attractive to work-for-food, and foster popular participation in development projects (Mbiribidi, 1987). Of the 55 districts in Zimbabwe, Buhera receives the largest amount of money for food-for-work projects (District Administrator, Buhera District, personal communication).

Concern has been raised that some of the food-for-work projects may not contribute to the creation of a stable or improved agricultural base, which would help to reduce the future impact of interseasonal rainfall variability. In Buhera, public works projects emphasise irrigation development, while Mutoko District Administration officials are planning on emphasising income-generating projects (Mutoko District Administrator, personal communication).

<u>Supplementary food production programme</u>

This intervention is aimed at improving the nutritional status of households. It is undertaken by the Ministry of Womens Affairs and Community Development, in conjunction with the Ministry of Health and AGRITEX. Villages are assisted to establish agricultural micro-projects which produce food products with high nutritional value, such as vegetable gardens and rabbit and poultry projects for protein production. These interventions were only observed in Mutoko and Mudzi.

<u>Household coping strategies</u>

Households adopt their own strategies to minimise the undesirable effects of food insecurity. These strategies are a function of the opportunities available to the household and its ability to take advantage of these opportunities. One strategy is to seek local wage employent to obtain cash income. Other strategies include out-migration from affected areas and disposal of durable assets. The preliminary survey did not investigate household coping strategies in the study areas. To date, there had been little empirical work in Zimbabwe to investigate neither household coping strategies for dealing with recurring food shortages in low-rainfall areas nor the contribution of employment generation in providing food security.

Technological strategies

Long term strategies for improving food security in low-rainfall areas include developing sustainable farming systems for these environments. One component of this strategy is the development of yield-stable and drought-tolerant crop varieties or hybrids. Currently, the Department of Research and Specialist Services (DR&SS) is conducting on-farm trials in Mudzi to evaluate sorghum varieties adapted to low-rainfall conditions which meet household food preferences (i.e., hard white grain).

In Buhera, Mudzi, and Mutoko, AGRITEX is using demonstration plots and field days to encourage farmers to adopt yield-increasing management practices, (i.e., tillage conservation, fertiliser application, appropriate plant population, and appropriate planting time).

PROPOSED RESEARCH FOCUS

The information obtained during the initial assessment of the food security situation in Mudzi, Mutoko, and Buhera Districts helped to establish future research priority in these areas.

The general objectives of the study are to examine the constraints and opportunities to increasing household food security in low-rainfall regions of Zimbabwe through the introduction of new oilseed and small grains technology with special attention on the interdependence between technology, institutions and policy.

The specific objectives of the study are to:

- describe and analyze the historical and current role of the oilseed and small grains subsectors in the agricultural economy; including aggregate supply (total production and marketings, imports; and interregional distribution of production and marketings); aggregate demand (end uses, including exports); technology development; institutional environment; and government policies (pricing, extension, credit);
- assess the historical and current role of oilseeds and small grains in the household production system;
- assess the food security status of households and identify factors associated with interhousehold variability in food security, with

particular emphasis on the role of government transfer programme in reducing household vulnerability to food insecurity;

- o identify strategies used by households to cope with production instability and the characteristics of households using alternative strategies, with particular emphasis placed on analyzing the role of non-farm employment and remittances as coping strategies;
- o assess the biological and economic performance of oilseeds and small grains in the historical and current production system in terms of returns to cash and labour inputs;
- o assess the potential of new oilseed and small grain technology for increasing household food security and the impact of the technology on interhousehold variability in food security;
- o assess the social, technical, economic, institutional, and policy constraints to introducing both improved oilseed and small grain production technology and the small grain dehulling technology;
- o assess the potential household and off-farm demand for small grains and small grain products--particularly blending with wheat--as an animal feed source and industrial uses; and constraints to capturing this potential demand;
- o identify alternative policy recommendations to facilitate the diffusion of new oilseed and small grain technology; including institutional, pricing, marketing, extension, credit, and research interventions.

Five parallel studies, using the same data set, will be carried out in Mutoko, Mudzi, and Buhera Districts to meet the objectives outlined above. Researchers will analyse components of the data set relevant to their specific research objectives. The five studies and their specific foci are:

- o The Contribution of Oilseed Production to Increasing Cash Income and Improving Household Food Security of in Low Rainfall Communal Lands. This study focuses on the role of oilseeds in household food security and their contribution to household cash incomes, economics of production technology potential, and constraints and opportunities for expanding production. The principal researcher is Godfrey Mudimu.
- o Determinants of Household Food Security in Low-rainfall areas of Zimbabwe. This study focuses on the role of different sources of income and expenditure; the impact of agricultural commercialization; and the impact of alternative policy interventions on household food security. The principle researcher is Charles Chopak.
- o Household and Industrial Demand for Small Grains: Implications for the Small Grain Subsector. This study focuses on assessing the demand for small grains; including historical, current, and potential future consumption patterns; and constraints and opportunities to

increasing on and off-farm demand/utilisation of both smallgrains and smallgrain products. The principal researcher is Charles Mbwanda.

- o The Impact of Market Development on Household Food Security in Low-Rainfall Areas of Zimbabwe. This study focuses on describing the marketing institutions (input supply, credit, output marketing, and transportation), assessing their effectiveness, and identifying policy interventions to strengthen their performance. The principal researcher is Solomon Chigume.
- o The Economics of Food Crop Production in Low-Rainfall Communal Lands. This study focuses on identifying technology adoption patterns, crop management strategies, farmer's assessment of technology options, and constraints and opportunities to increasing food crop production. The principal researcher is Jones Govere.

It is anticipated that these studies will provide an in-depth understanding of food insecurity in the research areas; identify the structure of income and expenditure flows; and identify technologies, institutional changes, and policies that will improve household food security in communal areas--particularly production of oilseeds and small grains, as well as greater household and industrial utilization of small grains.

CONCLUSION

The preliminary survey and the secondary data provided an insights into the household food security problems in Mutoko, Mudzi, and Buhera Communal Lands. The proposed studies will extend the depth and breadth of the analysis. It is anticipated that the insights gained will help policy makers, district and local administration organs, extension and research services, and households to reduce the threat of food insecurity.

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REFLECTIONS ON TWO DECADES OF RESEARCH ON SORGHUM-BASED FARMING SYSTEMS IN NORTHERN NIGERIA AND BOTSWANA

D.W. Norman, H. Sigwele and D. Baker[1]

INTRODUCTION

The subject assigned to us is a huge topic and has to be handled very selectively. Therefore, we only discuss issues which are directly related to food security. As was emphasised at last year's conference, there are two sides to food security; food availability and households having the resources to obtain food (Rukuni and Eicher, 1987). Both are now included in the SADCC policy for food security (Dhilwayo, 1987). While recognizing the critical nature of the linkage to macro policy, this paper focuses on the micro or household level. Also, rather than presenting detailed information on research activities and empirical findings, we make generalized statements about sorghum-producing households and farming systems patterns with the goal of deriving implications for future research.

The paper begins by comparing farming circumstances and sorghum production systems in northern Nigeria and Botswana. The comparison provides a background for characterising farmers' food security strategies. This is followed by a brief review of changes in research approaches that have occurred over the last 20 years in both countries. We propose that there is much complementarity between micro-level farming systems work and macro policy analysis in efforts to attain improved food security. On the basis of this perspective, we discuss in the fourth section some issues affecting the efficiency of future micro-level food security research.

COMPARISON BETWEEN AREAS

In the interests of brevity, we compare northern Nigeria and Botswana only with reference to three general topics: farmer aspirations and constraints, farming systems management, and food security strategies. These topics are not mutually exclusive and there are of course several other relevant topics.

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More detail on the two areas can be found elsewhere (Baker, 1987; ATIP, 1986a; ATIP, 1986b; Norman, Simmons and Hays, 1982).

Farmer aspirations and constraints

There is a certain universality in the aspirations of farming families. In economic terms, farming families try to maximize utility (satisfaction) which increases with real income, but decreases with higher levels of effort and risk. Attempts to maximise this utility take place within a set of constraints. As a result, it generally is not differences in aspirations but differences in the constraints which lead to the most important differences in farming systems. Such differences can be grouped in a number of ways. One classification is as follows (Norman, 1982):

- o natural conditions (e.g., climate, soil, etc);
- o factor (resource) endowments and prices; and
- o market or support systems for inputs and outputs.

The farming systems used by rural people are determined by all of the above. The natural environment determines the necessary conditions for the presence of a farming system while the socioeconomic circumstances provide the sufficient conditions for the presence of a farming system. Thus, differences in sorghum-based farming systems between northern Nigeria and Botswana result from a combination of the natural environment and socio-economic circumstances.

<u>Harshness of the natural environment</u>

In both areas, the most severe farming problems generally stem from limitations imposed by a lack of water. The seasonality of rainfall and its low annual level impose serious constraints on growing crops, and result in major variations in the demand for labour. In this sense, Botswana farmers operate under a much harsher climatic regime than those in northern Nigeria.

Also in both areas, soils are generally of poor quality, suffering from phosphorus deficiencies and low levels of organic matter. Particularly in Botswana, soils tend to have a low water-holding capacity and are subject to crusting following heavy rains. Soil erosion is a major problem in both areas, but is perhaps more severe in Botswana where many fields have been continuously cultivated for several decades.

Botswana farmers face two temperature problems which are not as important in northern Nigeria. First, the months when most planting is concentrated, because there usually is the greatest rainfall, are also the hottest months. Soil temperatures often exceed the cardinal level for sorghum seedling viability. The second problem is the onset of cool nights at the end of the season. If there are even short drought periods, during which sorghum stops growing, late January and February plantings may not have enough time to mature.

Variability in factor endowments

As summarized in Table 1, farmers in northern Nigeria and Botswana have significantly different factor endowments. Farming families tend to be smaller in Botswana. The size of the effective cropping labour force is even less relative to northern Nigeria than is suggested by family sizes. In Botswana, two-thirds of the active rural population are attending school, tending livestock, or engaged in off-farm wage employment. In contrast, Botswana farmers generally have more land, livestock, and fixed capital. Farms in Botswana usually range from 10-20 hectares, not including communal grazing areas, compared to less than five hectares in northern Nigeria. Moreover, Botswana farms consist of one or two contiguous blocks of land while those in Nigeria often are composed of scattered plots.

Most farmers in Botswana own one or more mouldboard ploughs and many own donkey carts. Because of a national equipment subsidy programme, farmers in parts of the country now also have purchased row planters and cultivators. In addition, Botswana farmers have a comparable range of hand tools and receptacles as those owned by Nigerian farmers.

Farming strategies can be significantly affected by the ability of farmers to withstand production shortfalls. Botswana farmers have a much greater ability to deal with crop failures because of their control of cattle assets. While many Botswana farmers do not own cattle, more than half are able to draw against their cattle inventories in the face of adverse circumstances, thereby stabilizing their standard of living.

National resource endowments can also affect farmers, as recent experiences in both Nigeria and Botswana have demonstrated. During the 1970s, oil revenues in Nigeria were used to fund numerous agricultural programmes. Such programmes have been severely affected by the fall in oil prices. In Botswana, government has used revenues from cattle and diamonds exports to subsidize farming families--substantially mitigating the most serious effects of the ongoing six-year drought.

Markets for inputs and outputs

In northern Nigeria, as in much of Africa, there are both formal and informal markets for inputs and outputs. Informal trade occurs among households and in periodic markets. The periodic markets facilitate inter-household trade and provide a channel for evacuating surplus production from rural to urban centres. Food items are available on an irregular basis and there is substantial seasonal price variation. There is limited trade in

Table 1. Selected aspects of farming systems: Mahalapye area, Botswana and Zaria, Nigeria (1976).

	Mahalapye area[a]	Zaria[b]
Climate:		
Rainfall (mm/year)	470	110
Rainfall > PET (months)	0	4
Length of growing season (months)	6-7	5-6
Farm Size:		
Cultivated land (ha)	5.1	3.2
Total (ha)	17	3.9
Any irrigation?	No	Yes
Field fragmentation	No	Yes
People:		
Religion	Christian	Moslem
Residences	Village, lands, cattlepost	One
Family size	7.7	8.8
Major "income" sources	Livestock, off-farm Beer brewing, remittances	Crops, off-farm smallstock
Cropping:		
Major crops	Sorghum, cowpeas watermelons, maize groundnuts	Millet, sorghum
Mean sorghum yield (kg/ha)	74	800
Self-sufficient in cereals	No	Yes
System:		
Power	Animal	Hand
Land preparation	Flat	Ridge
Planting system	Broadcast	Row
Sole/mixed crop	Mixed	Mixed
Weeding	1	2-3
Fertilizer	Little	Manure and inorganic
Livestock uses:	Sales, draught, transport, milk	Manure and Transport
Cropping labour (%)[c]		
Family: Adult males	19	72
Adult females	33	1
Children	15	9
Hired:	33	18
Peak labour demand:		
Main peak	Weeding	Weeding
Secondary peak	Harvesting	Harvesting
Male adult work time		
Percent on: Family farm/s	19	81
Livestock	53	5
Off-farm	28	34
Total hours	1034	1172

[a]1983. [b]1976. [c]Mahalapye percentages based on hours; Zaria based on days.
Sources: ATIP (1986a); Norman, Simmons and Hays (1982)

production inputs.

Following a pattern established during the colonial period, the Government of Nigeria has intervened extensively in agricultural markets (Norman, Simmons, and Hays, 1982). Many approaches have been tried for fertiliser distribution, but all have met with little success. Organized seed distribution was limited to cotton until the 1970s, resulting in limited use of improved varieties of most crops. Marketing boards exist for most commodities, but there have been many problems with the marketing board system.

In Botswana, local trade historically has been dominated by informal exchanges between households. Informal trades are made for labour, traction, gathered items, and household products on both a cash and barter basis. Interhousehold exchanges significantly increase the access of poor farming families to required production resources.

Complementing household exchanges, in Botswana there is a network of privately owned general traders which extends to essentially all villages. The general traders distribute imported agricultural commodities and other household goods to rural areas. Most of the items sold are either processed or manufactured, and are of nearly standardised quality. Prices are subject to a price control system based on wholesale prices and transport costs.

A recent study of the trading network in the Central Agricultural Region (Baker, 1987) showed that the trading network is making a major contribution to food security due to the provision of food commodities and, to a lesser extent, agricultural implements and fencing materials. Input availability is a problem in smaller villages, particularly for major implements, but reasonably priced transport is available. The availability and low prices of imported, milled food grains clearly affect farmers' incentives to invest in sorghum production. Thus, food security is increased through the marketing system, but the incentive to achieve food self-sufficiency is decreased.

Seed for sorghum and other crops is available through the Botswana Agricultural Marketing Board (BAMB) depots located in the larger villages. MAMB also announces guaranteed producer prices before the beginning of each season.

Farming systems management

Farmers in both areas have developed intricate farming systems that permit family labour utilization throughout the year and provide ways to profitably invest capital. However, there are some significant contrasts in farming systems management between the two areas.

Enterprise emphasis

In Botswana, rural people traditionally have been pastoralists while in northern Nigeria the emphasis has long been on crop cultivation. In addition to cultivating rainfed land, Nigerian farmers have also cultivated small amounts of land near rivers and streams that can be irrigated with simple irrigation systems. These traditional orientations continue to distinguish the areas.

In northern Nigeria, crops still constitute a more important component of farm and household income than in Botswana. Income from crop production accounts for more than a two-thirds of the total income of most households (Malton, 1977). Off-farm occupations, primarily within the village, are an important labour activity, but account for only a quarter of household income.

In Botswana, crop production is the third or fourth most important source of income for most households--following livestock tending (and sales), wage employment, and beer brewing. Remittances from families members working outside the village also tend to be a more important source of income than crop production at least for poor households. During the ongoing drought, even transfers from the government have provided more real income for many households than has crop production

Despite the importance of livestock in Botswana, there tends to be less complementarity between livestock and crop enterprises than in Nigeria. Animals generally are kept in a separate area from where crops are gown. Thus, the role of livestock as a provider of manure in Botswana is minimal. In northern Nigeria, such complementarities are maintained through pastoralists corralling their cattle on the fields of crop cultivators.

While out-of-village wage employment is very important in Botswana, in-village off-farm income opportunities are poorly developed, compared to northern Nigeria. For example, traditional marketing systems which provide many employment opportunities in West Africa are virtually nonexistent in Botswana. The reasons for this are not clear. One major factor may be that there has been no "engine of growth" in Botswana to foster its development, in the form of crops produced for disposal. Participation in the Southern African Customs Union has also restricted opportunities for the development of rural small-scale industries.

Sorghum production practices

Farmers in both areas want to increase total production from their cropping enterprise, but are using different strategies for attaining it. Some of the key differences are as follows:

o In Botswana, the much larger amounts of land cultivated per family member imply a land extensification (labour saving) farming systems management strategy. In northern Nigeria, farmers have more of a land intensification (yield-increasing) strategy.

- In Botswana, the prevalence of cattle led to the introduction of animal traction more than eight years ago. In contrast, in northern Nigeria most crop cultivation is done by hand, requiring more labour per unit area. Reflecting the tillage methods, ridging and hill planting systems are prominent in northern Nigeria, while in Botswana most crops are gown on the flat. Farmers simply broadcast the seed and plough it in.
- Fewer crops are (or can be) grown in the harsher climatic environment of Botswana. Thus, in northern Nigeria, farmers often grow different corps for sale than those that they consume. In Botswana, sorghum serves as the main food crop and cash crop. Relatively few farmers grow special crops just for sale. This means that sorghum plays a relatively more important role for farmers in Botswana than for those in northern Nigeria.
- Reflecting their intensification strategy, farmers in northern Nigeria use more chemical fertiliser, apply greater quantities of organic manure, and weed two to three times. In Botswana, farmers broadcast plant and plough as large an area as possible after each rain. Post-planting operations generally are confined to one weeding and bird scaring.
- The gender division of labour is substantially different between the two areas. In Botswana, adult females provide most of the labour for sorghum production, as well as for household maintenance activities. Males traditionally have been responsible for tending cattle. Animal traction ploughing, a task not commonly found in northern Nigeria, is the only arable farming activity which is dominated by men in Botswana. In contrast, males account for more than three-quarters of the labour for crop production in northern Nigeria.

As a result of the respective management systems, traditional sorghum yields are much lower in Botswana than in northern Nigeria. It should be emphasised that the management systems in both areas represent reasonable responses to the realities of the natural environments and socioeconomic circumstances.

Food security strategies

In light of the above area comparisons, it should not be surprising that farmers in the two areas have significantly different food security strategies.

Farmers in northern Nigeria depend on achieving a high degree of food self-sufficiency. Staple food grain supplies cannot be reliably obtained through market purchases. The limited amount of cash generated through sales of crops such as cotton, or from off-farm within-village employment, is largely needed for nonfood household requirements. Nigerian farmers can and do produce more of their food than Botswana farmers, but are quire susceptible to food shortfalls. Therefore, there is a great incentive to increase investments in crop production if the investments provide a reasonable and reliable return. A major issue facing northern Nigerian farmers is the balance in investment between sorghum and other crops.

In contrast, farming families in Botswana have systematically tried to minimize the linkage between food production and food security. While the main objective of growing sorghum is to meet household food grain requirements (Baker, 1987), no households actually rely on food self-sufficiency. Instead, most food is purchased using cash from a combination of several sources. If the rains are good and a sufficient quantity of sorghum is produced, it is a welcome event. The money which would have been spent on food becomes available for other items. The food security strategy of Botswana farmers implies that capital or labour investments in sorghum production usually are not a top household priority. This poses a major challenge to technology development researchers.

CHANGES IN RESEARCH APPROACHES

There are two complementary approaches to increasing the productivity of farming families and improving their food security situation.

- o Develop and disseminate relevant improved technologies, which enable households to use resources previously underutilized an/or increase the productivity of resources already being utilized.
- o Develop relevant policies (e.g., pricing systems) and support systems (e.g., extension, credit, improved input distribution programmes on the input side, and markets for the products produced). The development of relevant policies and support systems can entail a combination of macro- and micro-level research.

Both components are needed to facilitate increased agriculture productivity and improved food security. Which is relatively more important is location and time specific. In this section we characterise the research which has been conducted in order to facilitate the development of sorghum-based farming systems and discuss the need for a micro-macro balance in future research.

Overview

Throughout Africa, there has been an evolution in the approaches used to address the needs of farming families over the last 20 to 30 years. This evolution is described below. Until now, the later components listed generally have not replaced the earlier ones. Rather, the additional components were incorporated over time in response to perceived weaknesses.

1. Prior to the 1960s. There were two main thrusts to technology development research. Both primarily focused on boosting the output of export crops. One strategy emphasised crop-variety improvement, with the objectives of increasing yields and insect and disease resistance. There was a limited amount of agronomic research to develop recommendations on plant spacing, fertilisation, and other husbandry practices for the new varieties. The second component entailed the selective transferring of mechanical and biological technologies from areas with more productive farming systems. Beginning in the 1950, station based, inductive research to develop technologies adapted to the natural environment became important. Little was known about the functioning of local markets and support systems research was not viewed a high priority.
2. 1960s. In northern Nigeria, detailed quantitative studies were undertaken by social scientists with the aim of understanding the rationality of limited resource farmers within the socio economic environments in which they were operating. There usually was little interaction with station-based technical scientists. Social science research (focused on improving farming systems and food security) was still lacking in Botswana.
3. Mid-1970s and early-1980s. The popularisation of farming systems work took place with its emphasis on the diagnosis of existing farming systems; and the design, testing, and dissemination of relevant improved technologies. Emphasis during this period was increasingly placed on cooperation with experiment station based scientists and involving farmers as active participants in the process of developing relevant improved technologies. The emphasis shifted from collecting quantitative data to qualitative understanding. Towards the end of the period, increasing concern was expressed about building linkages with extension and policy makers.
4. Mid-1980s. Concern over food security issues is leading to an increasing emphasis on policy issues and macroeconomic analysis.

Discussion

During the past 26 years, tremendous progress has been made in the way research on farm productivity and food security issues is being conducted. As a result, our understanding of the determinants of food security has greatly increased. At this point, it is almost inconceivable that inter-disciplinary on-farm research could be discontinued. It also seems that no one should have to argue for the importance of understanding existing farming systems.

One of the most important issues at present is what is an appropriate balance between micro research on farming systems and macro policy analysis. It is our belief that it would be a mistake if macro policy research became the sole focus--or even the primary focus--of food security analysis (and donor agency funding) in the late 1980s.

We believe that micro-level farming system work--encompassing both technologies and support systems--plays a vital complementary role to policy analysis in efforts to achieve improved food security. Changes in policy without changes in technology are unlikely to solve long-run problems of food security. Certainly the insights and data collected in farming systems work should be of value to food security personnel working at the macro-level.

ISSUES AFFECTING FUTURE RESEARCH

Based on the assumption that micro-level farming systems work will continue, we now will discuss several insights from past farming systems work and derive implications for future food security-related research. As above, our emphasis is on the development of relevant technologies and support systems.

Within area resource distribution

The way in which resources are distributed within areas can critically influence the welfare of individual families. Although national statistics might indicate the average family can attain food security, aggregation can mask underlying inequalities that need to be addressed. There is in fact evidence from both northern Nigeria and Botswana that resources are unequally distributed, thereby resulting in unequal income distribution (Malton, 1977; CSO, 1976), Moreover, there is qualitative evidence that inequality may be increasing in the face of growing populations, periodic drought, and a breakdown of traditional egalitarian notions of shared poverty.

Inequalities in resources and income distribution lead to a number of consideration in micro-level food security research, six of which are the following:

- o On-farm versus off-farm income. Matlong (1977) produced cross-sectional income distribution data from an area slightly north of Zaria in northern Nigeria. He showed that incomes from farming activities were less variable than from off-farm sources. He further found that, although in absolute terms incomes from farming activities were much lower for poorer families, farm incomes as a proportion of total incomes were higher. As a result, farming income contributed both to greater income and income equality.

In Botswana, the potential of crop farming in creating rural income and employment opportunities is recognised in national policy. However, cropping income is less stable than livestock production or wage employment. If poor farmers are to be helped by cropping activities, attention must be given to stabilising cropping income.

- Level of food consumption. Evidence from both northern Nigeria and Botswana shows that many rural families, particularly poorer families, do not feed themselves. For example, Matlon found 60% of the farming families did not produce enough or retain enough food to feed themselves. Richer households had income from other sources to purchase enough food to make up the deficit, but 20% of the poorer households did not.

  In Botswana, Baker (1987) showed that poorer families consume most food items less frequently. Less grain is consumed per person in poorer households and poor households are more dependent on purchased food. In general, those households which are poorer and consume less, also are the least successful crop farmers.
- Seasonal hunger. In the face of low income, seasonal hunger becomes a critical issue. Seasonal hunger is characterized by food availability being at its lowest level at a time when the demands of the agricultural cycle are highest; and cash resources are also at their lowest. The effect of the hungry gap, as it is sometimes called, on the physical constitution of the hungry are fairly obvious. During the peak of the agricultural cycle individual calorie and protein consumption is insufficient (Grant, 1970) and a loss of weight tends to occur. A potential for further debilitating effects is created, since the chances of contracting nutritionally-related diseases are increased and the resistance of the body to other illnesses is decreased (Chambers *et al*, 1979).
- Dependency relationships. Inequality and associated food access problems create a milieu in which poverty is sustained and deepened because of the development of dependency relationships. Chambers *et al.* (1979) have pointed out, for example, that such short-run problems of overcoming hunger through working on other peoples land for cash, or through borrowing money and pledging land, can lead to a ratchet effect with a downward spiral. As a result, commitments made to survive one year lead to a lower potential income in future years.
- Compromises in technical efficiency. There is substantial evidence

that differences in technical efficiency often stem less from managerial ability than from compromises made to deal with inadequate income and resources. For example, in northern Nigeria the urgent need for food and cash make it necessary for members of low income families to work at off-farm occupations, thereby forcing farmers to delay planting sorghum and millet and delay the first weeding (Malton et al, 1979). As a result, poorer household are disproportionally represented amongst the least technically efficient producers.

Comparable compromises are observed in Botswana. Nearly half the households rely on other households for traction resources. In order to gain access, dependent households have to provide cash or labour for ploughing the traction owner's field. In order to obtain cash for food as well as ploughing, some family members emigrate for wage employment. Therefore, whether paying in labour or cash, draught dependent households consistently end up ploughing later and often have less people available for weeding. The result is a significant inverse relationship between levels of sorghum production (due to yields and area ploughed) and household resources (Baker, 1987).

- Relevance of technical solutions. Water shortages is the over-riding constraint for most farmers in Botswana and for many farmers in northern Nigeria. There are alternative tillage and planting practices which address water shortages. Whether they can be implemented depends, to a great extent, on the resources farmers have at their disposal. For example, in Botswana it is critically important to ensure ploughing is done as soon as possible after rains, in order to make sure water is available for germination and plant growth (although some farmers do take the chance that germination will result from a post-planting rain). Obviously, timely ploughing is easier for a tractor-owning farmer than for a farmer who has to hire donkeys. The challenge is to develop relevant guidelines for poor farmers as well as for farmers having access to greater levels of resources.

Increasing returns to the limiting factor

Farmers clearly take into account the impact of interventions on their most limiting resources. One of the main lessons from farming systems work is that technology development research must also pay attention to which factors are most limiting for which farmers. Whether land or labour will be the more limiting factor will tend to be location specific. However, ratios of land and labour can be very crudely simplified into three possible situations:

- In areas of low population density, the peak demand period for labour is likely to be the major constraining factor on expanded output.

- In areas of transition to high population densities, it is possible that both labour and land constraints will emerge. The peak demand period for labour will be a constraining influence and land will emerge as a problem because soil fertility will decline under population pressure. The possible dual nature of these constraints will be exacerbated by the increasing need, in order to sustain a satisfactory level of living, for farm families to spend more time in activities that require year around commitments--including off-farm income earning activities, as well as caring for livestock owned by the family. As land becomes more of a constraint, the value of livestock in contributing to maintaining soil fertility will become greater. However, the problem of feeding livestock will also become greater; and quite likely will involve a change to more labour intensive methods.
- In areas of very high population density, where labour becomes surplus, land is likely to be the most constraining factor.

The relative factor ratios given above suggest two basic priorities in efforts to introduce relevant technologies; first, improving the productivity of labour at bottleneck periods, and secondly, improving the strategies--such as introducing mechanisation to solve the problem of seasonal labour bottlenecks and bio-chemical technology to increase land productivity--are too simplistic.

There are three key issues which must be considered when determining a strategy to address farmers' limiting factors.

First, interventions designed to increase the return to the most limiting factor indirectly affect the use and/or productivity of other factors. For example, labour-saving technologies such as herbicides or inter-row mechanical cultivation--if used to peak labour periods--can improve yields due to more timely field operations. Yield-increasing technologies (e.g., improved seed; fertiliser; pest, disease, and weed control; improved cultural practices; etc.) will--if there is no change in the power base--usually increase labour demands. Depending on the degree to which yields are increased, this can have either a positive or negative impact on labour productivity.

Second, multiple binding constraints can be present in a single area, particularly if resources are inequitably distributed. However, it is not easy in semi-arid areas to design technologies that result in an increase in both land and labour productivity. For example, in a number of improved crop technology packages examined in Northern Nigeria, the only one that increased the productivity of both land and labour in a spectacular way was maize.

In Botswana we have had even more problems identifying packages which relate to land and labour constraints. One possible technology is double-ploughing, the first one of which is undertaken in order to permit more water to enter the profile and be available at planting on the second ploughing operation. Our research over five years has shown that farmers facing a land constraint can obtain 75% higher yields and increased farm profits by double ploughing. Returns to ploughing labour also tend to be higher with double ploughing. However, the data supporting double ploughing for farmers who face only a ploughing or weeding labour constraint, not a land constraint, are less convincing.

Third, a very obvious requirement is the necessity of fitting technologies together with the complementary support systems. For example, in northern Nigeria the maize technology mentioned above could only be adopted by farmers when the World Bank came in with a series of agricultural development projects that had good distribution systems for inputs and provided markets for the output. In Botswana, double ploughing is not easy to advocate currently, particularly for those farmers facing a labour limitation, since a current development programme is heavily subsidising single ploughing of the land. This subsidy is not available for a second ploughing and therefore the costs and returns to farmers are less favourable than they would be otherwise.

Exploiting flexibility versus breaking constraints

Limiting factors can be addressed either through breaking constraints or by exploiting flexibility that exists in current farming systems. For example, in northern Nigeria planting labour is a limiting factor. Farmers avoid the limitation by planting cotton after food crops have been planted. Although lower yields are obtained due to late planting, the climatic environment permits some return from late season labour and land that would otherwise be underutilised.

In Botswana farming systems there are many fewer opportunities for exploiting flexibility. For example, because of low yields, it was necessary to break a planting labour constraint by turning to animal traction. The area cultivated increased and now farmers are faced with a weeding labour constraint. The timing of weeding cannot be greatly shifted because early weeding interferes with ploughing and necessitates a second weeding, while late weeding conflicts with bird scaring and early harvesting. A good alternative for overcoming the limitation is to introduce row planting and mechanical inter-row cultivation. This would be what we term "breaking the constraint" rather than exploiting flexibility.

In general, breaking constrains can lead to substantial improvements. However, investments required for breaking constraints generally are much greater than those used in exploiting flexibility. Also, there are often negative equity implications associated with a "breaking constraints" strategy. Therefore, it is desirable to pursue a balanced approach, even if the opportunities for exploiting flexibility appear to be limited.

We have made some progress following this strategy in Botswana. For example, we have tried to break the water limitation through new tillage systems, all of which require control of traction resources. At the same time, we have taken advantage of the fact that in many households female labour is underutilized during the ploughing and planting period to develop a recommendation that women should invest time in post-establishment stand management (thinning and hand gap filling). A more even plant population makes better use of limited amounts of soil moisture.

Understanding the logic of farmers' practices

There is plenty of evidence that farmers in both areas have devised ways of surviving in their high risk natural environments. Research on crop mixtures, carried out 26 years ago in northern Nigeria, showed quite clearly that attempts to improve food security should pay serious attention to farmers' existing strategies and practices.

Data collected on crop mixtures in northern Nigeria showed that the gross margin per hectare was between 60 and 70% higher for crop mixtures. Although the total labour input for growing crops in mixtures was higher than in sole stands, the return per person hour during the major labour bottleneck period (June/July) was 20% higher for crop mixtures. Therefore, mixed cropping not only alleviated the labour bottleneck, but also paid off in terms of returns to that limited seasonal labour. The results also showed that growing crops in mixtures gave a more dependable return. This is not altogether surprising since different crops have different growing cycles, differing demands on soil nutrients, different rooting habits, and different susceptibilities to insect and disease attacks. As a result, failure or partial failure of one crop can sometimes be counteracted by compensatory growth by another.

We are not proposing that growing crops in mixtures is always the best strategy. In fact, there is some evidence to the contrary in Botswana because secondary crops such as cowpeas tend to out compete sorghum for the limited water. However, farmers recognise this and tend to plant extremely low populations of secondary crops in their sorghum-based crop mixtures. From an agronomic standpoint, their mixtures are effectively sole sorghum plantings. However, the secondary crops do make a major contribution to dietary diversity and help stabilize production in years when the primary sorghum crop fails.

The need for options and guidelines

The more unpredictable the rainfall is, the more likely farmers will adjust their cropping strategies depending on how the year develops. In such environments (if not all environments), it is unlikely that a single strategy will work every year. Therefore, technical scientists need to think in terms of a number of options that can be suggested to farmers.

A closely related issue is the need for guidelines (auxiliary information). As Byerlee (1986) has argued, technical scientists have tended to concentrate on developing recommendations (prescriptive information). They often have not given guidelines on fallback strategies if the recommendation is not applied according to specifications, or extra information that can help extension staff and farmers adapt the recommendations to their own circumstances. Such auxiliary information is very important and needs to be incorporated in recommendations.

Minimize the requirements for purchased inputs

As indicated earlier, farmers in harsh climatic environment buffer their farming systems through off-farm enterprises and livestock activities. Thus, any proposed intervention must be evaluated in terms of whether the resources used for implementing that intervention could be better and more reliably invested in activities other than arable agriculture. For example, in Botswana, few farmers are willing to invest cash in crop production since relatively few perceive crop production as a reliable way to produce a farm income.

Unless governments are willing and able to subsidize agricultural production, agronomist may be best occupied in the development of practices that require relatively low levels of extra inputs. Similarly, plant breeders should concentrate relatively more on modifying the plant to fit the environment rather than expecting the environment to be modified to fit the plant, a strategy that was so spectacularly successful in the green revolution.

Technology ladder and farmer subsidies

Conventional wisdom is that there is a technology ladder, initially involving the use of divisible inputs such as improved seed and fertiliser, followed by pesticides ad herbicides, and then later by lumpier more indivisible inputs such as mechanisation. In areas of high population density where the land/labour ration is low, such strategies often are feasible; but in areas with high land/labour ratios, the first step up the technology ladder is likely to be labour-saving equipment. This is the case in Botswana where timeliness of operation is so important, and the first step for many farming families is obtaining access to draught animals and a plough.

It is apparent in the very harsh environment of Botswana that, without draught animals and related equipment, there is relatively little that can be done to help farmers more reliably produce their food grain requirements. Therefore, improving access to draught power through the judicious use of pricing policy and support systems management can help the more disadvantaged farmers meet the preconditions to improved productivity.

The commitment necessary on the part of the government in providing lumpy inputs is relatively greater than providing divisible inputs. Therefore, the issue of subsidies for traction and equipment is an important area where there needs to be close coordination between technical scientists and policy analysts. When designing farmer assistance programmes, an important issue is ensuring equal access by male and female farmers. This issue is not discussed in this paper, but is quite important in Botswana.

Sustaining land productivity

As human and animal populations increase, pressures on the relatively fragile land base also increase. Soil conservation is important in sustaining the potential for food security. However, unfortunately the closer farming families are to subsistence levels of living, the more short-run their articulated needs inevitably become. Consequently, for soil conservation strategies to work, there must be a convergence between the short-run private interests of farmers and long-run societal interests. In certain situations, trees used as fodder and fuel can provide this convergence, but in general, such conservation can only be implemented through substantial levels of subsidisation and/or considerable political will.

In Botswana, a national conservation strategy is currently being developed. The strategies being suggested will cost considerable amounts of money. Also, the crucial issue of controlling cattle access on the communal grazing areas still remains unresolved. Cattle ownership is very skewed in Botswana and some of the individuals responsible for changing policy are the ones who stand to lose most from such controlled access. Thus, personal and political considerations are likely to influence policy decisions affecting the balance between private and societal interests.

Balance between on-farm and off-farm opportunities

As discussed above, farmers in northern Nigeria and Botswana engage in an intricate web of crops, livestock, and off-farm activities. Until now, we have addressed farm production, with an emphasis on staple food grain (sorghum) production.

Despite the focus of this paper on sorghum production, we believe it is necessary for policy analysts to have a wider perspective than simply the adoption of technologies. Policy analysis and support systems improvement need to address the whole farming system. Off-farm employment is a great generator of employment and income. More explicit attention is needed on the part of many governments to employment in the informal sector in rural areas.

CONCLUSIONS

By helping sorghum-producing families, who constitute the majority of families in Botswana and northern Nigeria, to produce more sorghum and engage in other income-earning activities, we can contribute significantly to their attaining food security.

Reflecting on the past two decades of research, it is apparent that many errors have been made in our attempts to help small farmers attain food security. But there has also been some progress in developing an understanding of research priorities.

From our experiences we are convinced that, in order to design and develop technologies that farmers are likely to adopt, it is necessary to put ourselves closer to the natural and socioeconomic environment in which they operated. This has perhaps been the greatest strength and contribution of farming systems work. Stemming from farming systems work, there has been a move away from monolithic technology packages and toward the increased targeting of practices.

Much progress is still required, particularly in developing relevant policies and support systems that complement the role of relevant technologies in improving the productivity and food security of farming families on a sustainable basis. Appropriate policies and support systems can widen the possible applicability of technologies developed to address heterogeneity in the natural and socioeconomic environment. Thus micro-level farming systems work and macro policy analysis are important complements in efforts to attain food security.

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ACCESS TO FOOD

THE ROLE OF THE GOVERNMENT OF BOTSWANA IN INCREASING RURAL AND URBAN ACCESS TO FOOD

K. F. Mokobi and S. Asefa[1]

INTRODUCTION

The Republic of Botswana is a land-locked country of 1.1 million people located in Southern Africa. It has a nonracial democracy which sharply contrasts with its neighbours, the Republic of South Africa and Namibia (Southwest Africa). Thus, Botswana is continually called upon to provide humanitarian assistance to refugees from its neighbours (Botswana, 1985c).

The country's physical environment is characterized by a permanent state of drought. It experiences drought in some form seven out of every ten years. (Holm and Morgan, 1985).

Consequently, its domestic food grain production is low. During normal season, it only produces 33% of its annual grain requirement of about 200,000 mt, mainly maize and sorghum. During drought years, domestic production decreases to about 5% of domestic requirement. Thus, Botswana must import about 67% of its domestic requirement during a normal season and up to 95% during a drought period. While the country is deficient in food grain production, it has a large cattle population estimated at 2.4 million in 1985, that ensures the survival of many rural households.

Botswana's food and agricultural problems are fully recognized by the government and are considered in its national economic priority agenda. In the November 1985 *National Food Strategy* paper, the state identified the following three problem areas of the country's agricultural economy: inadequate domestic food production, inadequate nutrition and access[2], and large food import and aid dependence--due to the country's geographic location,

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[1]Director, Department of Food Resources and Economics Department, University of Botswana, respectively.

[2]Inadequate nutrition is especially severe among young children. A recent study estimated that about 25% of children are underweight in non-drought years. This figure rose to 30% during the 1982 to 1985 drought (Botswana, 1985a).

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the potential political instability in Southern Africa, and its implication for national food security (Botswana, 1985a).

OBJECTIVES

This paper examines the role of the Government of Botswana in increasing rural and urban access to food in the short-run, within the framework of the priorities and goals established by the country's national food strategy (NFS), by:

- o summarizing the country's national food strategy which determines the framework for the study;
- o describing the country's food access programmes, including the institutional framework for designing and implementing the programmes;
- o providing an analytical framework for assessing food access policy options in the short-run which have linkages to long-run economic development;
- o describing the National Rural Employment Food Access Programme, a component of the country's national food strategy;
- o providing alternative methodologies for economic analysis of the programme; and
- o drawing potential policy implications for Botswana and other Southern African nations.

EVOLUTION OF THE NATIONAL FOOD STRATEGY

The foundation for the national food strategy was laid nine years after independence, when the government began to develop a strategy for the livestock sector by hiring an international consultant. The consultant, Steven Sandford, recommended designing drought relief projects that focussed on people instead of livestock. This led to a 1978 national conference sponsored by the Botswana Society, which focussed on the human aspect of drought and placed drought at the top of the national government's policy agenda. In 1983 the Ministry of Finance and Development Planning established a high level committee of civil servants to design a national food strategy to identify ways and means to increase local food production, strengthen nutrition-oriented services, and augment existing capacities to respond to drought (Holm and Morgan, p. 472).

A working group was established in 1984 to formulate the national food strategy on behalf of the Rural Development Council (RDC), which was responsible for coordinating the NFS under the Ministry of Finance and Development Planning. In July 1984, the Rural Development Council adopted a detailed report on the NFS which became the basis for the November 1985 government paper adopted by the Botswana National Assembly.

The NFS, through its link to the national planning process, is now regarded as an evolving medium term policy instrument. Its primary purpose is to provide a coherent framework for formulating and implementing a whole range of food security related programmes affecting various sectors of the economy *(Ibid)*.

BOTSWANA'S FOOD SECURITY AND ACCESS PROGRAMME

The goals of Botswana's national food strategy are to insure a minimum acceptable diet for all Botswana and to build and maintain national capacity to deal with drought.

Programme components

To effectively implement these goals, the government established a short-run food security programme known as the Drought Relief Programme. This consists of two food access programmes (human relief and rural employment) and two food availability programmes (agricultural relief and recovery and water supply). Figure 1 shows the conceptual classification of these programmes in relation to the government's national food strategy.

Human relief programmes

A supplemental feeding programme distributes food to vulnerable groups, including malnourished children, destitutes, the elderly, primary school children, pregnant and lactating women, and remote rural dwellers. In 1984 about 60% of Botswana's population received supplementary feeding on a regular basis with the programme providing 21% of their calorie needs.

During nondrought years, food is provided five days a week in primary schools to all pupils, at health centres to medically selected preschool children, as well as to pregnant and lactating women. During drought years, the criterion of medical selection in clinics is dropped and all school children continue to receive a midday meal at school. Registered destitutes and nonschool children up to ten years of age are also fed during the drought period. Whenever possible, the feeding programme is complemented by nutrition education to encourage the use of local foods of high nutritional quality (Holm and Morgan, 1985, p. 468).

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              Short-run food security programmes
                        (drought relief)
                        /            \
                       /              \
                      /                \
    Food access (demand) <----> Food availability (supply)
         programmes                    programmes
             /\                            /\
            /  \                          /  \
           /    \                        /    \
          /      \                      /      \
 Human Relief <----> Rural <----> Agric. <----> Water
 (supplemental     employment      relief        supply
   feeding       (labour-based  programmes   programmes
 programme)  relief programme)
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Figure 1. Programmes in Botswana's national food strategy

National rural employment programme

A labour-based relief programme (LBRP) provides employment in short-run seasonal public works projects at a rate below the national daily wage. Public projects are selected by village development committees to provide immediate relief to drought-stricken households through cash income-earning opportunities. Projects are also intended to create useful and productive village infrastructure. One of the major rural employment projects involves hand-stamping of sorghum for school feeding by rural women on a piecework payment basis *(Ibid)*.

Agricultural relief and recovery programme

This programme assists farmers to increase agricultural production by providing free seeds, vaccination services, and subsidized livestock feed. It funds water supply improvement and administers a cattle purchase scheme by buying older cattle from farmers at guaranteed prices. The programme also subsidizes draft power hiring for farmers with inadequate ploughing resources (Botswana, 1985c; Holm and Morgan, 1985).

Water supply programme

This component provides funds to district water councils to meet the demand for water transportation and borehole maintenance imposed by drought. It also provides assistance to rehabilitate existing water systems and to construct new water systems in communities with extreme water shortages (Botswana, 1985a).

Administrative structure

The overall food security programme, with its four components, is administered by the cooperative efforts of five ministries: the Ministries of Local Government and Lands; Agriculture; Mineral Resources and Water Affairs; Health; and Education. The Department of Food Resources of the Ministry of Local Government and Lands implements the human relief programme in cooperation with the Ministries of Health and Education. The Ministry of Health cooperates with the Department of Food Resources in monitoring the nutrition situation and in organizing on-site feeding of malnourished and vulnerable children; while the Ministry of Education oversees the feeding of primary school children. The Department of Food Resources also administers and implements the rural employment programme. The Ministry of Agriculture implements the agricultural relief and recovery programme, while the water supply programme is under the Ministry of Mineral Resources and Water Affairs.

An Inter-Ministerial Drought Committee (IMDC), coordinated by the Rural Development Council of the Ministry of Finance and Development Planning, oversees the activities of the five government ministries. The IMDC, through its small early-warning technical group, collects data and reports monthly on rainfall, soil moisture, production, and the nutritional status of the population. These reports provide policy direction for institutions implementing the drought relief programmes (Botswana, 1985a, Holm and Morgan, 1985).

FOOD ACCESS STRATEGIES AND ISSUES

A recent World Bank policy study of poverty and hunger identified lack of food access as the most crucial global food security problem.

> The world has ample food. The growth of global food production has been faster than the unprecedented population growth of the past 40 years ... yet many poor countries and hundreds and millions of poor people do not share in this abundance. They suffer from lack of food security caused mainly by a lack of purchasing power (World Bank, 1985).

The idea that lack of food access is primarily caused by poverty and lack of purchasing power is not new. However, until recently there existed no detailed economic analysis to show the relationship between food insecurity and lack of food access caused by poverty and entitlement failure. Sen's pioneering study (Sen, 1981) of poverty and famine showed that some of the worst famines--including the Bengal famine (1943), the Ethiopian famine (1973, 1974), the Bangladesh famine (1974), and the Sahelian famine (1977)--were due to lack of food access caused by poverty, loss of income, and exchange entitlement failure *(Ibid)*. The crucial role of food access in food security is highlighted in Reutlinger's definition of food security: "Access by all people at all times to enough food for an active and healthy life" (Reutlinger, 1985).

However, emphasis on food access does not mean that food availability--the supply side of the food security equation--can be ignored. Ensuring that all members of a given society have access to enough food at all times involves both food availability (supply) and food access (demand) considerations (Rukuni and Eicher, 1987).

Long-run strategies

Achieving food security through providing food access and reducing poverty has both short-run and long-run dimensions. In the long run, a strategy of economic growth with equitable income distribution is the best means of reducing rural poverty and providing access to food. But the long-run strategy is a time consuming and difficult task that can easily be blocked or delayed by an unfavourable policy environment caused by such factors as political instability, wars, bad economic policy, and poor management.

Short-run strategies

Thus, until a long-run strategy of poverty alleviation linked with employment-based agricultural growth and increased food production is put in place to provide the purchasing power needed for food access, explicit short-run food security strategies are needed to provide the poor with access to food (Gittinger, *et al.*, 1977).

<u>The role of domestic food production, food aid, and imports</u>

This strategy involves directed policies that change domestic food prices, or food import and export prices (Rukuni and Eicher, 1987). While such policies are easy to administer, they may distort relative food prices and create potential inefficiencies in food production (Timmer, 1986; Timmer, *et al.*, 1983). They may also involve serious political costs such as high food prices which lead to urban political instability. However, the careful use of food aid can ameliorate the possible short-run welfare losses by urban consumers until the long-run potential welfare gains to rural producers and society at large are realized (Timmer, 1986).

The role of income and food transfers

These programmes, including supplementary feeding and cash transfers, are widely used as a short-run food access strategy. A commonly practiced method involves food rationing to targeted groups at "fair price shops" (i.e., below market prices) or distributing food freely at health or feeding centres during hunger periods (Timmer, *et al.*, 1983). In some cases, this strategy benefits those with better access to feeding centres, such as urban dwellers compared to the rural population in remote areas. The strategy also suffers from leakages of transfer payments to unintended beneficiaries.

Botswana's membership in the Customs Union with Lesotho, South Africa, and Swaziland provides national access to food. No one can starve as long as they have access to cash. Since urban dwellers generally have better access to a regular income, supplementary feeding is deliberately targeted more towards the rural population. First, "remote area dwellers" (i.e., a popular expression referring to all people, including the Basarwa) in settlements far away from the social service centers are entitled to a food transfer. During drought, food transfers have been an integral part of the supplementary feeding programme run by the Department of Food Resources. Second, all rural health facilities have been turned into feeding points which receive a regular food supply which is distributed to their clients. Third, all primary schools serve a midday meal to all their pupils. In the rural areas, during drought years school feeding is provided continuously, even over weekends and school holidays. The Department of Food Resources supplies food to 500-600 primary schools and 500-600 feeding centers throughout the country. The government categorizes vulnerable group beneficiaries who receive rations from the health facilities as pregnant mothers, lactating mothers, preschool children, TB outpatients, children six to ten years old not at school, permanent destitute (group A), temporary destitute (group B), underweight children, and severely underweight children.

Permanent destitutes, people who have become destitutes for one reason or other during the years, have always been wards of the Social and Community Development Unit of the Ministry of Local Government and Lands. Temporary destitutes are individuals rendered destitute by the effects of prolonged drought. The longer the drought persists, the less households have to share with relatives and the more the extended family shrinks, dropping out those on the periphery. Underweight children are directly fed at the health facilities. Severely malnourished are fed with a mixture of dried skimmed milk, vegetable oil, and sugar--popularly known as Disco Milk. The Department of Food Resources, guided by policies formulated at the Inter-

Ministerial Drought Committee, is responsible for implementing the supplementary feeding effectively and efficiently.

The role of rural public employment

This strategy has proved more attractive than those discussed previously, especially if the programme employs the poorest and most vulnerable groups. On the other hand, unless carefully designed and implemented these programmes are potentially inefficient due to the low value of products and services produced by the projects, relative to their cost *(Ibid).*

In Botswana, labour-based relief projects provide temporary village level employment to people whose income source has been eroded by the effects of prolonged drought. They have also proved useful in constructing much-needed rural infrastructure and productive assets such as dams and hand dug wells. Another component of this programme is the hand-stamping project, by which women in rural areas are employed by the Parent Teacher Associations to hand-stamp the sorghum which is fed to primary school pupils.

The programme is projected to provide a minimum of 50,000 workplaces in 1987-88 (16,250 person years of employment) which will be rotated among 75,000 beneficiaries. The projects are chosen by rural villagers through village development committees, with supervision and technical advice provided by district administration and district council staff. Each district and sub district has a district drought committee which employs a district drought coordinator and a labour-based relief project technical officer. Government believes that the programme provides an important injection of cash into rural areas that helps the most disadvantaged households maintain a minimum level income and, at the same time, keeps small traders and rural entrepreneurs in business. Although the wages are well below the market rate, they are adjusted every year to counter the effects of inflation. However, it is recognised that the rapid expansion of the programme has led to inadequate project supervision by poorly trained personnel. This, coupled with the urgent need to arrest the devastating effects of drought, has led to low productivity and poor workmanship. Currently, plans are underway to expand the programme and turn it into a development programme when the drought abates. Incorporated into this plan are efforts to improve supervision, particularly through the establishment of training course in labour management and appropriate techniques.

ISSUES IN DESIGNING AND IMPLEMENTING SHORT-RUN FOOD ACCESS PROGRAMMES

Short-run food access programmes must be designed and implemented with careful consideration of their cost-effectiveness, appropriate targeting, and their nutritional effects.

Cost-effectiveness

Cost-effectiveness of a food access programme is a direct function of the degree of targeting, including administrative costs involved. Targeting involves identifying the truly needy and vulnerable based on such criteria as income, location, commodity, sex, and age. Timmer, Falcon, and Pearson classify targeted programmes to include food stamps, fair price shops, supplementary feeding for vulnerable groups, price subsidies for inferior foods, food-for-work, cash-for-work, and rural employment programmes. Nontargeted programmes include general food ration schemes and fair price shops with unrestricted access; as well as such policy instruments as overvalued exchange rate, general food price policy, and subsidizing food production inputs such as fertilizer, water, credit, seed, and machinery (Timmer, *et al.*, 1983, p. 64).

How to design efficient targeted food access programmes that minimize leakages is an important research question that needs further attention in Botswana.

Targeting

Botswana's supplementary feeding programme is reasonably well targeted to vulnerable groups. Recent data collected by the Rural Development Unit shows that between October 1986 and January 1987, the programme served an average of 383,000 beneficiaries per month. The vulnerable groups reached during this period included pregnant women (18,032), lactating mothers (44,420), preschool children (171,426), TB outpatients (6,257), nonschool children six and ten years of age (84,044), permanent destitutes (35,215), underweight children (15,857), and severely underweight children (1,284).

Nutrition

The nutritional dimension is another crucial aspect of designing and implementing short-run food access programmes. Increased food access is by itself insufficient to solve malnutrition because economic variables such as income and prices are not the only determinants of the nutritional status (Gittinger, *et al.*, 1987).

Designing and implementing nutritional programmes require careful planning to integrate them into the overall food access strategy and to disaggregate and target the intervention. Targeted programmes may focus on material and child clinics, nutrition education, and supplying vitamins and minerals to deficient groups. Untargeted programmes may include general nutrition education, fortification of food such as iodizing salt, encouraging breast-feeding and appropriate use of infant formula, and establishing effective public health programmes in areas of clean water, sanitation, and inoculation. (Timmer, *et al.*, 1983, p. 64).

SRI LANKA'S FOOD ACCESS EXPERIENCE

While Botswana and each SADCC nation must design its own food access programme based on its own particular situation, comparative experiences can provide useful lessons.

Sri Lanka has extensive experience with targeted and nontargeted food access programmes. In 1960, the government made available to everyone a free ration of 2 lbs of rice per week. In 1970, government supplemented the free rice scheme with an additional 2 lbs of rice at a subsidized price. In 1977, the general rice subsidy was replaced by a targeted programme focused on the poorest half of the population. In 1979, Sri Lanka replaced its four decade old food subsidy scheme, characterized by price subsidies and rationing of rice, with a targeted food stamp scheme based on income (Edirisinge, 1987). The new strategy was effective in reaching the lowest 70% of the population and in reducing the net food subsidy from 14% of government expenditure in 1970 to about 4% in 1984 (Bhalla and Glewwe, 1986; Edirisinge, 1987).

Contrasting the equity-oriented approach of the pre-1977 period with the post-1977 economic growth approach, Bhalla and Glewwe conclude that the latter strategy had a greater effect in raising economic welfare. However, their study suffered from measurement errors. Reestimation of the regression equation used in the study showed that they overstated the effect of post-1977 policies on social indicators (Isemman, 1987). A further drawback of the study is that the authors' interpretation of Sri Lanka's experience as a test case for the "equity versus growth" approach to poverty alleviation and economic development obscures the synthesis and complementarity of the two approaches *(Ibid)*.

Sri Lanka faced several problems in implementing its food stamp scheme which was aimed at the poorest 20% of the population. Large leakages to upper income households reduced the cost-effectiveness of the transfer programme. However, in spite of implementation problems, Sri Lanka managed to integrate welfare policies of subsidized food, free eduction, and health care services that enabled it to achieve developed country standards in health, literacy, and life expectancy. For instance, in 1984 with 16 million people and a per capita income of only US$360, the average life expectancy was 70 years. This was higher than any other low-income country in the world, comparable to industrial countries such as Austria and Ireland (World Bank, 1986).

BOTSWANA'S RURAL EMPLOYMENT PROGRAMME

The rural public employment food access programme is a part of Botswana's national food strategy. These projects (officially called labour-based relief projects) are designed to create directly productive assets such as irrigation, drainage, land reclamation, reforestation, and soil conservation measures; economic structures such as roads and bridges that facilitate market and economic activities; and social infrastructure projects such as schools, clinics, and water supply construction that create social capital (Clay, 1980, p. 1239).

Unresolved issues

A recent survey of literature on public employment programmes identified several issues which are relevant to the Botswana progrmme, including:

- o how to ensure effective participation by those most in need;
- o how to generate projects that combine employment potential for the unskilled at the right place in the right season with a socially useful end product;
- o how to respond to the leakage of resources before they reach intended beneficiaries;
- o how to ensure that projects produce assets of an adequate standard and at reasonable cost; and
- o how to guarantee that the benefits are distributed to those most in need (*Ibid*, p. 1237).

Despite the vast literature addressing these concerns, controversies remain about public works programmes, especially regarding the scale and distribution of short term employment benefits (i.e., who benefits and to what extent); their long term impact on employment and incomes; their cost-effectiveness; as well as the broader political and macroeconomic significance of public works.

Project goals

The goal of Botswana's public employment programmes (LBRP) is to provide supplemental income and temporary relief to drought-stricken communities. Its implementation follows a presidential decree that initially stated that every settlement with 100 or more inhabitants must be reached by some public employment programme (Botswana, 1985b, p. 22). Many of the projects are seasonal and are usually discontinued in early December to give farmers a chance for ploughing, after which work resumes in two to three months *(Ibid)*.

Employment generation

In 1984-85, the employment programme provided an estimated 40,000 to 70,000 short term seasonal jobs to able-bodied adults in rural areas at a relief wage of P2.00 (pula) or US$1.20/day (Holm and Morgan, 1985). The labour intensive projects are selected by village development committees.

One of the major projects employs women to hand-stamp sorghum grain into flour for school feeding. This programme created about 3,000 to 5,000 jobs during 1984-85. Thirteen other rural employment projects--including building, roads, airstrips, dams, drift fences, fire breaks, kraals, tribal shelters, pit latrines, soil reclamation, wells, clearing land, making gardens, and brick moulding--provided about 38,000 to 65,000 jobs (Botswana, 1985b, p. 24).

Constraints faced

The programme faces budget, technical, and administrative constraints. In recent years, a number of volunteer agencies make technical volunteers available to the Food Resources Department, thereby reducing technical constraints. For instance, during 1984-85, 12 volunteers were employed as labour based relief project technical officers to assist drought relief coordinators and other district level project personnel. In 1984-85, 30 heavy-duty and 25 light vehicles were available to transport materials, workers, and district officials supervising various rural projects.

METHODOLOGY FOR ANALYZING RURAL EMPLOYMENT PROGRAMME

Cost-benefit and cost-effectiveness analysis are two approaches that can be used to evaluate Botswana's rural employment programme.

Cost-benefit analysis

This approach is used to determine whether rural employment programmes make society as a whole better off than other food access programmes alternative such as supplementary feeding. Benefits are measured in terms of social benefits. While less precisely measurable than private revenues, this concept reflects the perspective of society rather than the individual. To measure costs, the social opportunity cost or social value sacrificed elsewhere in moving factors to rural employment programmes is used. The evaluation objective is to estimate social benefit over social cost for all Botswana.

The starting point of applying the cost-benefit methodology to rural employment programme is to identify and measure all benefits and costs including primary, secondary, pecuniary, and intangible ones. Primary benefits consist of the value of goods and services generated by a specific public works project. For instance, for land reclamation and irrigation projects, the analysis must estimate the increased value of crops produced on reclaimed and irrigated land--less the costs of seeds, labour, and equipment used in crop production (McGuigan and Mayer, 1986). The number of jobs and total wage income gained from the project can be incorporated into primary benefits. There are also important pecuniary and intangible benefits which are difficult to measure such as lowered input costs, increased rural economic activity, improved land values, improved quality of life, improved balance of payments, and a stable socio-political environment that may result from decreased rural unemployment and slower rural-to-urban migration.

Public employment project also have primary, secondary, pecuniary, and intangible costs. Primary costs such as direct outlays for services, equipment, wages, and salaries are relatively easy to measure. In addition, the opportunity cost of resources devoted to the programme must be fully accounted for in estimating total economic cost. For instance, while we may assume unskilled rural labour utilized in public projects may have low or zero opportunity cost, the opportunity cost of other resources, (capital, administrative, and managerial) must be considered in calculating the total economic costs of the programme.

Cost-effectiveness analysis

This alternative approach is used when the benefits of a public project programme cannot be meaningfully quantified (McGuigan and Moyer, 1986). In applying this method to rural employment programmes, we assume that the benefits of the programme are identifiable and socially useful, and proceed to analyze how this level of social benefit can be achieved at least-cost. In other words, assuming that Botswana can achieve some level of food access through rural employment programme, the objective is to determine the most efficient combination of alternative public projects that should be adopted.

For instance, should resources be allocated to all of the country's 13 labour-based relief projects and the sorghum hand-stamping programme, or is it possible to identify and implement the most cost-effective combination of these projects? Most of the necessary data for such analysis should be available from rural household surveys and the Department of Food Resources.

IMPLICATIONS FOR BOTSWANA AND OTHER SADCC NATIONS

While Botswana's experience with rural employment programme and other food access strategies has implications for other SADCC states, the country is in many ways unique--relative to her neighbours in Southern Africa.

Unique features

First, the seven year drought has mobilized indigenous national institutions to mitigate the effect of drought. Second, most Botswana are concentrated in groups of 5,000 to 35,000 along the 500 mile road network in the eastern part of the country. This geographic concentration facilitates programme effectiveness. Third, revenues generated by a diamond-led rapidly growing economy provides adequate foreign exchange to import food. Fourth, Botswana is a representative democracy which is rare in the region. Fifth, the country encourages foreign and domestic private investment in trade and transportation and receives substantial foreign aid. For instance, 20% of the country's cereal consumption was provided by foreign donors (Holm and Morgan, 1985). Botswana has attracted more foreign aid, relative to the African nations[3], because:

- o It has the necessary institutions and infrastructure to move food aid relatively quickly and effectively to the needy in times of food crisis.
- o It has a flourishing private sector that is consistent with the idealogy of its western donors.
- o Donor countries are interested in reinforcing the political stability of one of the few working democracies in Africa, as well as showing solidarity with friendly SADCC states surrounding South Africa *(Ibid)*.

Thus, it may be difficult for other SADCC or African countries to easily draw upon Botswana's experience with rural employment and other food access programmes because most of these nations either lack the resource base to finance large food access programmes, or lack the efficient bureaucracy and decentralized democratic institutions that allow public agencies and officials to deal with the needs of the rural population.

[3]For instance, in 1985 Botswana, which had one of the highest per capita incomes in Africa, received 39 kg/person in food aid, compared to much poorer Niger which received only 25.4 kg/person. (See Holm and Morgan, 1985, p. 478).

Questions raised

For Botswana, the experience in designing and implementing food access programmes such as public rural employment programme raises fundamental questions about the long-run sustainability of its development strategy. Can Botswana sustain financing its expensive food access programmes? How can these programmes be linked to long-term development? To achieve sustainable long-run development, Botswana needs to expand both agricultural and nonagricultural employment and bridge the gap between short-run relief efforts and long-run development needs. It can only achieve this by creating a diversified labour intensive employment based economy which is not susceptible to a potential fall in diamond or cattle prices or a sudden decrease in food aid.

CONCLUSION

Botswana's experience suggests that drought and famine is best managed as an income and employment problem, rather than a food nonavailability problem. This approach provides the rationale for labour-based relief programmes designed to replace lost income sources and offer short-term employment to the temporarily unemployed.

While sustainability and linkage to long-run development are critical issues, the political and social benefits of Botswana's short-run food access programme should not be overlooked. These expenditures are investments in human capital that increase the vigor and productivity of the rural population. In addition, they have a long-run intergenerational effect on the country's social and economic development. A country whose children experience continuous malnutrition will incur large economic and social costs in the long-run, and is unlikely to sustain economic development.

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THE ROLE OF NONFARM ACTIVITIES IN THE RURAL ECONOMY

P. Kilby and C. Liedholm[1]

INTRODUCTION

Until recently it has been conventional to roughly equate the rural economy with the agricultural economy. With from 30-70% of the nation's population, the primary function of rural households was envisioned as the production of food and fibre for the home market and one or more crops for the export market. In addition to farm production, household members might as secondary activities engage in agricultural processing, transporting and marketing.

In the past few years, this view has begun to change with growing recognition that the nonfarm sector plays an important welfare-augmenting role in providing simple consumer goods and services to poorer rural households (Johnston and Kilby, 1975; Mellor, 1976; Chuta and Liedholm, 1979; and Anderson and Leiserson, 1980). Furthermore, the provision of these goods and services provides a humble but critical income to landless labour. But most policy makers still imagine the nonfarm sector as passive--with its size wholly dependent upon the level of farm income and making no independent contribution to economic growth.

This paper draws upon recent research, to delineate the nonfarm rural economy--its magnitude, its anatomy, and how it changes over time. We present evidence that nonfarm activities not only make a major welfare contribution with respect to equity and income-smoothing, but that many of these activities add more to gross domestic product (GDP) than the substitute goods and services supplied by technically-advanced capital intensive producers. Finally, we argue that the sector is no more or less passive than any other sector in the economy, and that it can make substantial contributions to agricultural growth.

SIZE OF THE NONFARM SECTOR

Given that conventional statistical measures of employment and output do not exist for most nonfarm activities, how can we measure the sector's size? There are three ways. First, frequently information is available on occupational classification of the rural population that is collected during the de-

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cennial population census. Second, there are especially-designed establishment surveys within a given sample area. Finally, there are rural household income and expenditure surveys undertaken within the context of a national sampling design.

Census estimates

Table 1 presents mainly census based figures on the share of the rural labour force whose primary occupation lies outside of farming. Although the range runs from 14-49%, in over three-quarters of the countries the nonfarm share is between 19-28%. While this itself is a very large magnitude, it is nevertheless an underestimate (e.g., larger rural towns are excluded, women's nonfarm work is undercounted, secondary occupations--which net out heavily in favour of nonfarm activities--are omitted).

Table 2, showing the composition of nonfarm activities, is also mainly derived from census data. While there is considerable variation between the nine countries, the three major components are manufacturing (including agricultural processing and repair activities), trading, and services. Since trading is the most common secondary occupation, this category is probably understated.

Establishment survey estimates

A second source of information on the rural nonfarm sector is the specially-designed establishment survey. These are generally limited to manufacturing units which, because of their relative fixity of location, are easier to count than concerns engaged in, say, transportation, construction, or petty trade. Table 3, which reports the percentage of total manufacturing employment that occurs in the rural areas, is primarily derived from this type of sample survey. These percentages are usually built up as follows: formal urban employment (plus some large-scale processing employment in rural areas) are obtained from the standard statistical series, to which are added employment estimates for fabricating activities in the urban informal sector with the final component provided by the rural establishment survey.

Are the data in Table 3 to be believed--that in 10 of the 13 countries, rural areas account for over half of manufacturing employment? Like census data, establishment surveys are not entirely reliable with respect to aggregate measurement; but unlike census data, we cannot say whether the result is an overestimate or an underestimate. This type of survey does not capture noncommercial production (for own consumption) and surely overlooks

Table 1. Percentage of rural labour force with primary employment in rural non farm activities.

Country	Year	Coverage	Rural nonfarm labour force (%)[a]
Guatemala	1964	All rural	14
Thailand	1970	All rural	18
Sierra Leone	1976	Male-rural	19
South Korea	1970	All rural	19
Pakistan	1970	Punjab only	19
Nigeria	1966	Male-3 dist. W. state	19
India	1966	All rural	20
Uganda	1967	4 rural villages	20
Afghanistan	1971	Male-Paktia Region	22
Mexico	1970	All-Sinaloa State	23
Columbia	1970	All rural	23
Indonesia	1971	All rural	24
Venezuela	1969	All rural	27
Kenya	1970	All rural	28
Philippines	1971	All rural	28
W. Malaysia	1970	All rural	32
Iran	1972	All rural	33
Taiwan	1966	All rural	49

[a]Percent of rural labour force primarily employed in nonfarm activities.
Source: Chuta and Liedholm (1979).

Table 2. Sectoral composition of rural nonfarm employment in selected countries (%).

	Afghan-istan 1970	India 1966	Indo-nesia 1971	Sierra Leone 1975	Phil-ippines 1970	Korea 1970	Colom-bia 1970	Malay-sia 1970	Tai wan 1966
Manufacturing	46	39	29	40	34	30	33	22	27
Construction	9	14	5	2	11	10	8	5	4
Trade & Comm.	11	14	34	35	15	24	19	22	13
Services	10	24	27	23	30	29	33	41	50
Other[a]	24	9	5	0	10	7	7	10	6
	100	100	100	100	100	100	100	100	100

[a]Includes utilities, transport, and miscellaneous; omits other and unknown.
Source: Chuta and Liedholm (1979).

Table 3. Manufacturing (large and small-scale) employment in rural areas (%)[a].

Country	Year	Percent	Country	Year	Percent
Sierra Leone	1976	86	Philippines	1976	61
Indonesia	1976	80	India	1967	57
Sri Lanka	1971	75	Pakistan	1975	52
Jamaica	1980	74	Taiwan	1976	49
Ghana	1973	72	Malaysia	1970	46
Zambia	1985	64	Korea	1975	30

[a]Rural defined as all localities under 20,000 inhabitants.
Source: Liedholm and Mead (1986).

some out-of-the-way small producers[2]. This source of undercounting can be magnified or reversed by both the particular point in the agricultural cycle that the survey took place (since part-time work constitutes a large share of nonfarm activities) and the geographical areas of the country sampled (since the volume of nonfarm activities typically varies substantially by region). Hence, there is no obvious bias in the estimates reported in Table 3. The likelihood that they are too low is equal to the probability that they are too high.

Specially-designed establishment surveys also provide considerable information about the nature and functioning of the nonfarm sector. While firm size may range over 20 employees, most of these rural nonfarm firms are very small[3]. Liedholm and Mead's (1986) review of evidence from over a dozen countries reveals that 85% of the small rural manufacturing firms employed fewer than five employees with the one-person firm generally dominating. Larger units engage both unpaid family workers and wage-paid employees. Combined fixed and working capital per person is typically modest. Unlike the enumerated wage labour force, women constitute a large fraction--40% or more--of those engaged in the sector and frequently account for the majority of the small-scale entrepreneurs. Acquisition of skills takes place through apprenticeship and other forms of learning-by-doing.

Rural household income survey estimates

Rural household income survey, if constructed for the purpose, provide the most accurate measurement of both employment and output[4]. These surveys

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[2]Comparisons of the street-by-street, village-by-village enterprise censuses, conducted by MSU and host country scholars, with official censuses find that the latter frequently undercount the number of small enterprises by a factor of two or more (Liedholm and Mead, 1986).

[3]Small-scale firms employ less than 50 persons. Rural is localities with 20,000 inhabitants or less.

[4]Similar cost-route surveys to collect weekly data from small firms were conducted by MSU and host country scholars in Sierra Leone, Bangladesh, Jamaica, Honduras, Thailand and Egypt. (Liedholm and Mead, 1986).

are based upon a carefully drawn random sample of several thousand rural households, from whom weekly data is collected over the course of a year--including household receipts by source, expenditures, labour allocation, and a host of supplementary variables. Problems of part-time work, seasonality, overlooked enterprises, secondary occupations--all vanish. The bad news is that such surveys are extremely expensive and require great organizing abilities from the statistical agency in charge. Consequently, this desirable source of information is not often available.

Comparing the nonfarm income share for five countries (Table 4) with primary employment (%) in nonfarm activities (Table 1) reveals that in four out of the five countries, the income share is substantially larger than the primary occupation share. The one exception, Taiwan, is almost certainly the result of the decade discrepancy between the two measurements. If these few figures are indicative, we may tentatively conclude that the nonfarm sector ranges from one-half to three-quarters the size of the agricultural sector. Thus it constitutes a major sector in all low and middle-income economies.

EQUITY IMPACT OF RURAL NONFARM ACTIVITIES

Are rural nonfarm activities a major source of income for the poorest rural households? If so, do they reduce income inequality in rural areas? Do they also contribute to stabilizing income among poorer households over the course of the year? Answers to these questions should provide us with a reasonably comprehensive assessment of the equity issue.

Landholding size and nonfarm activities

Given that land is the farmer's principal productive asset, size of holdings has commonly been used as a variable to stratify rural households into income classes. How important is rural nonfarm income for those with little or no land? Not surprisingly, data from five countries in Asia and Africa (Table 5) reveals an inverse relationship between size of landholding and the share of nonfarm income in total rural household income. For the smallest landholding categories in each country, nonfarm income sources account for over 50% of household income.

Is the income derived from these nonfarm sources sufficient to reduce income inequalities within the rural areas of these economies? For the two African cases, as well as Thailand (Table 5), the nonfarm income sources raise the total income of rural households with the smallest amounts of land to above the incomes of those with somewhat larger farms. This vertical J-shaped relationship between total rural household income and landholdings is perhaps not unexpected in Africa, where land is not a limiting factor. It also

Table 4. Share of nonfarm income in total rural household income.

Country	Year	Percent
Northern Nigeria (3 villages)	1974	28
Korea	1980	34
Sierra Leone	1974	36
Taiwan	1975	43
Thailand	1978	43

Sources: Northern Nigeria: Matlon (1977); Korea: Korea (1981); Sierra Leone: Unpublished results from Sierra Leone African Rural Employment project reported in Chuta and Liedholm (1979), (includes households in rural towns plus in villages); Taiwan: Taiwan (1981); Thailand: World Bank (1983).

appears to hold in some parts of Asia, such as in Thailand and Japan, but it is not ubiquitous (see Korea and Taiwan in Table 5).

However, these general findings, call into question the notion that farm size is a consistently good proxy for total rural household income or a good indicator of who are the rural poor. Indeed, a complex set of factors bearing on farming, nonfarm enterprises and off-farm trading and employment opportunities determine rural household income levels. Although this heterogeneity complicates the task facing policy makers in dealing with the rural poor, it also means that there is a much wider set of opportunities that can be developed.

Nonfarm activities reduce income inequality

Therefore, relating the total nonfarm income share to total rural household income is a better indicator of whether or not rural nonfarm income reduces income inequality. Although information on this relationship is sparse, data are available for Sierra Leone, Nigeria, and Thailand. Table 6, in which rural nonfarm income shares are related to total rural household income quintiles or terciles (from low to high), again reveals the vertical J-shaped

Table 5. Size of land holding and relative importance of nonfarm income in total household income.

Country	Year	Size of holding (acres)	Household income: Nonfarm share (%)	Household income: Total (US$)
Korea	1980	0.00 - 1.23	74	3,005
		1.24 - 2.47	39	3,450
		2.48 - 3.70	28	4,321
		3.71 - 4.94	23	5,472
		4.95 +	16	7,401
Taiwan	1975	0.00 - 1.23	70	2,768
		1.24 - 2.47	52	3,442
		2.48 - 3.71	44	3,701
		3.72 - 4.94	39	4,570
		4.95 +	26	5,566
Thailand (4 regions)	1980-81	0.00 - 4.10	88	1,362
		4.20 - 10.20	72	974
		10.30 - 41.00	56	1,613
		41.00 +	45	1,654
Sierra Leone	1974	0.00 - 1.00	50	587
		1.01 - 5.00	23	404
		5.01 - 10.00	14	546
		10.01 - 15.00	12	770
		15.00 +	15	927
Northern Nigeria	1974	0.00 - 2.46	57	479
		2.47 - 4.93	31	377
		4.94 - 7.40	26	569
		7.41 - 9.87	15	769
		9.88 +	24	868

Sources: Korea (1981); Taiwan (1977); Northern Nigeria: Matlon (1977); Sierra Leone: Matlon *et. al.*, 1979. The average nonfarm share is lower than that reported in Table 4 because only rural households were interviewed. Thailand: Narongchai, *et. al.* (1983). Some of the villages were chosen because of their varieties of nonfarm activities. Thus, they are not "representative" of the entire country. For the whole country, the nonfarm income share for farm households is 43%. (World Bank, 1983).

Table 6 . Percentage of rural household income earned from farm and nonfarm sources by income class.

Country	Income class	Farm	Nonfarm
Sierra Leone	Tercile		
	Lowest	80.3	19.7
	Middle	81.2	18.8
	Highest	80.0	20.0
Northern Nigeria	Quintile		
	Lowest	76.6	23.4
	Middle	78.0	22.0
	Highest	61.4	38.6
Thailand	Quintile		
	Lowest	37.5	62.5
	Middle	44.0	56.0
	Highest	34.9	65.1

Sources: See Table 5.

relationship. Thus, rural nonfarm income is relatively important at both ends of the income distribution spectrum, although different types of nonfarm income are important at the low and high income ends of the distribution. For low income rural household, wages from working on other's farms and service-type activities are the predominant income sources. For the high income households, salaries from administrative and manufacturing activities tend to predominate. These latter activities tend to have higher entry barriers and yield higher returns than agriculture or the other types of rural nonfarm activities (Chuta and Liedholm, 1979).

What is the net effect of these various nonfarm income sources on overall income inequality in rural areas? The results from two African studies as well as from Thailand indicate that including nonfarm income with farm income reduces the rural Gini coefficients in each case.

Gini coefficients calculated on per capita farm income alone were 0.43 in Sierra Leone and 0.32 in Nigeria, compared with coefficients on combined farm and nonfarm incomes (rural) of 0.38 and 0.28, respectively (Matlon *et. al.*, 1979). In rural Thailand, the Gini declines from 0.58 when only farm income is considered to 0.38 when all the sources of the rural households' income are included (Norongchai, 1983). The available evidence, although limited, does suggest that rural nonfarm income reduces rural income inequalities in several countries.

Nonfarm activities smooth annual income flows

Rural nonfarm activities also contribute to the smoothing of household income over the year. For example, analysis of the monthly income fluctuations of 424 rural households in Thailand reveals that the variability of total household income was considerably less than the variability of net farm income over the year (Nonongchai, 1983)[5]. Studies from Northern Nigeria and Sierra Leone point to similar findings, (Matlon, *et. al.*, 1979). Farm and nonfarm activities tend to move in opposite directions over the year and income earned from nonfarm sources complement the pattern of net farm income received. Thus, nonfarm activities seem to make an important welfare contribution with respect to both equity and income stability in rural areas.

EFFICIENCY OF RURAL NONFARM ENTERPRISES

Are these rural nonfarm enterprises efficient users of economic resources? Although, these enterprises seem to possess equity virtues with respect to the distribution of income, they are frequently viewed as inefficient, thus, confronting policymakers with a potentially vexing trade-off. However, if some categories of rural nonfarm enterprises are found to generate more real output per unit of resources expended than their larger-scale urban counterparts, then agricultural and other policies that enhance these activities can increase both output and employment.

Employment would increase if the labour capital ratio of smaller firms exceeded those of the larger ones. Virtually all empirical studies find that small rural enterprises are more labour intensive (usually measured in terms

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[5]The coefficient of variation (CV) for net farm income was 2.07, but only 0.64 for total household income, which includes nonfarm income sources.

of the labour-capital ratio) than their larger scale counterparts in the aggregate. At the industry-specific level, the same results generally hold, although a few exceptions exist such as in Korea. (Liedholm and Mead 1986).

Partial efficiency measures
The evidence on the economic efficiency of rural nonfarm activity is rather meagre. Comparisons of small and large-scale enterprises using partial efficiency measures (particularly the output-capital ratio) have been made, but these have yielded a mixed picture of the relationship between capital productivity and size (Page and Steel, 1984; Liedholm and Mead, 1986). Moreover, only rarely are rural and non industrial enterprises specifically examined in these analyses. These studies also suffer from the limitations that surround all partial efficiency measures; if some resource other than the one included in the measure is scarce and thus has a non-zero opportunity cost, then it may yield incorrect results.

Comprehensive efficiency measures
Comprehensive economic efficiency measures, such as total factor productivity and social benefit-cost analysis, overcome the limitations of the partial ones (Biggs, 1986). Ideally, all scarce resources are explicitly included in the analysis and are evaluated at their shadow or social prices that reflect their scarcity values in the economy. Unfortunately, only a few such studies exist (Ho, 1980; Cortes, *et al.* 1985) and none consider rural nonfarm enterprises explicitly.

Relative efficiency
Liedholm and Mead (1986) recently used a social benefit-cost measure to compare the relative efficiency of small rural manufacturing enterprises with their larger-scale urban counterparts in Sierra Leone, Honduras, and Jamaica. Following the approach suggested in Cortes *et al.* (1985), the ratio of the enterprise's value added to the cost of its capital and labour, both valued at

their shadow or social prices, was used to measure economic efficiency[6]. An SBC ratio > 1 means the enterprise has a positive effect on total output of the whole. A ratio of < 1 means it has a negative effect. If domestic rather than social prices are used to evaluate value added, the SBC can only be used to compare enterprises in the same sector.

The primary data used to derive the social benefit-cost ratios were generated from the detailed small-scale industry surveys that Michigan State University and host country researchers had conducted. Approximately 495 rural manufacturing firms were surveyed in Honduras (Stallmann, 1983), 200 in Sierra Leone (Chuta and Liedholm, 1985), and 150 in Jamaica (Fisseha, 1982). Firms were interviewed twice weekly over a 12 month period to obtain daily information on revenues and costs. The information on the large-scale enterprises was obtained from the worksheets used to construct the Industrial Censuses in Sierra Leone and Honduras and from the National Planning agency's Industrial Survey in Jamaica. In calculating the social benefit-cost ratios, the shadow social price of capital was assumed to be 20%, while unpaid family labour was valued at the average price for skilled labour in small-scale industry[7]. Since world prices for outputs and material inputs were not available for the Honduras and Jamaican studies, domestic prices were used. This means efficiency comparisons had to be limited to large and small rural enterprises operating in the same product group with reasonably similar mixes of output and purchased inputs.

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[6]More specifically, the social benefit cost ratios (SBC) is calculated on the basis of the following formula:

$$SBC = \frac{VA}{r_s K + w_s L}$$

where: VA = value added

r_s = shadow or social price (interest rate) of capital

K = total fixed and working capital

w_s = shadow or social price of labour

L = total labour hours, including family and apprentice hours.

[7]The actual wages paid to all workers in large-scale enterprises were included at 80%. (Haggblade, Liedholm and Mead, 1986).

Key findings
The key finding from this three-country analysis is that in a majority of the industry groups considered, the small manufacturing enterprises used fewer resources per unit of output than their larger-scale counterparts. Table 7 reveals that the social benefit-cost ratios are higher for rural small-scale enterprises in 8 of the 12 cases examined. Only in the wearing apparel industries of Jamaica and Honduras and the shoe and furniture industries of Sierra Leone, do the larger-sized enterprises prevail. Moreover, the social benefit-cost ratios for small rural nonfarm enterprises exceed one in all but two industries. Such findings provide limited support for the contention that some small rural nonfarm activities in developing countries are economically efficient. Ho (1980) for Korea and Cortes *et. al.* (1985) for Colombia find that large-scale enterprises tend to be more efficient than their smaller-scale counterparts, using comprehensive efficiency measures. However, they do not explicitly consider rural activities.

One weakness of this analysis is that output and purchased inputs were valued using domestic, rather than world prices. Fortunately, sufficient data were available from Sierra Leone to compute enterprise social benefit-cost ratios at world prices.

This analysis, summarized in Table 8, reveals that at world (social) prices small-scale manufacturing enterprises in Sierra Leone are more efficient than their small-scale counterparts in all enterprise groups considered, except for shoes. The aggregate social benefit-cost ratio for rural small-scale industries is +1.57, indicating that small industries, overall, are economically efficient and have a positive effect on the total output of the Sierra Leone economy. Moreover, except for furniture, the ratios for the individual industries all exceed one, indicating their positive contributions to the economy as well. By contrast, the social-benefit cost ratios for large-scale industry is 0.49 overall, and exceeds one in only a single industry group, shoes. The large-scale activities, consequently have a negative effect on the Sierra Leone economy. Thus, a shift of resources to rural small industry would appear to make economic sense.

EFFECT OF EXPENDITURE PATTERNS ON SIZE OF THE RURAL NONFARM ECONOMY

What determines how large the rural nonfarm economy is in a given country and what are its likely growth prospects? This can be approached by examining the expenditure patterns for goods and services that this sector could supply; and analyzing the supply response of rural nonfarm enterprises.

Table 7. Social benefit cost ratios (domestic prices)[a] for various large and rural small-scale industry groups in Sierra Leone, Honduras, and Jamaica.

Country/enterprise/group	Year	Rural small-scale[b]	Large-scale[b]
Sierra Leone	1974-75		
Bakery		1.86	1.03
Wearing apparel		1.78	0.53
Shoes		1.65	2.00
Furniture		0.81	0.87
Metal products		1.63	1.61
Honduras	1979		
Wearing apparel		0.82	0.89
Shoes		1.27	0.54
Furniture		1.44	0.84
Metal products		1.21	0.74
Jamaica	1979		
Wearing apparel		1.00	1.79
Furniture		2.51	1.36
Metal products		1.87	1.58

[a]Gross output and purchased input values used to compute value added (numerator) are evaluated at domestic prices; hired labour valued at actual wages paid for small and at 0.8 of actual wages for large. Unpaid family valued at skilled wage rate for small-scale industry. Capital was evaluated at a shadow interest rate of 20%. For a rationale for these particular shadow rates, see Haggblade, Liedholm, and Mead (1986). [b]Small-scale firms employ less than 50 persons. [c]Large-scale firms employ 50 persons or more. With one exception, these firms are located in large urban areas.

Source: Sierra Leone: small-scale enterprise date, Chuta and Liedholm (1985); large-scale data from worksheets used to generate Census of Manufacturing figures of Central Planning Unit, Government of Sierra Leone, 1974-75. Honduras: small-scale enterprise data, Stallman (1983); large-scale industry data obtained from worksheets used to construct the 1975 Census of Industry. Jamaica: small-scale enterprises data, Fisseha (1982); large-scale data collected from worksheets used by the National Planning Agency for their 1977 industrial survey.

Table 8. Social benefit-cost ratios large-[a] and rural small-scale[b] manufacturing enterprises 1974-75, Sierra Leone.

Industry	Domestic prices[c]		World prices[d]	
	Rural Small Scale	Large Scale	Rural Small Scale	Large Scale
Food				
Bakeries	1.86	1.03	1.80	0.68
Beverages	e	1.79	e	0.89
Others	e	4.41	e	-2.46
Textiles				
Wearing apparel	1.76	0.53	1.38	-0.30
Gara cloth	4.82	e	3.68	e
Shoes	1.65	2.00	1.14	1.40
Wood				
Furniture	0.81	0.87	0.52	0.48
Metal				
Metal products	1.63	1.61	1.16	0.90
Repairs	4.78	e	4.78	e
All	1,94	1.74	1.57	0.49

[a]Large firms employ 50 or more persons; [b]Small firms employ less than 50 persons; [c]For the social benefit-cost ratio, the gross output and purchased input values used to compute value added (numerator) are evaluated at actual prices in Sierra Leone; hired labour is evaluated at the market wage for small and at 0.8 of actual wage for the large; apprentice labour is evaluated at Le 0.06/hour and family labour at Le .16/hour; capital is evaluated at 20% using the capital recovery factor for the fixed component; [d]For the social benefit-cost ratio (world prices), the gross output and purchased input values at domestic prices were adjusted from the nominal tariffs on imported elements. Where quantitative restrictions applied, such as for flour, the difference between c.i.f. import prices and domestic prices were used. [e]Data not available.

Sources: Small-scale enterprise data reported in Chuta and Liedholm (1985); large scale enterprise data obtained from Census of Manufacturing data collected by Central Planning Unit, Government of Sierra Leone 1974-75. Data were obtained from 15 of the 28 large industry; these firms accounted for over 90% of the large industry value added. Customs data obtained from the government. Specific tariffs converted to ad valorem rates based on current f.o.b. prices.

Consumer goods and services

We begin with the best documented and largest class of expenditures, namely consumer goods and services. Although rural household expenditure studies are not uncommon, they typically do not distinguish the source of various consumption goods (e.g., whether the shoes purchased were made overseas, in a major urban area, or in the rural economy). Investigations which do draw this distinction have been carried out in Sierra Leone (King and Byerlee, 1978), Nigeria, and Malaysia (Hazell and Roell, 1983).

In these countries, the combined budget share of food expenditures (including alcohol and tobacco) ranges from two-thirds to four-fifths of household spending (Table 9). This, of course, reflects modest levels of per capita income in all rural economies. The lesser reliance on home-produced food in the Muda area of Malaysia and the greater reliance on food imported from outside the region are the joint effect of higher income level and more specialized agriculture.

Among the goods and services that make up the local nonfood category are tailor-made clothing, footwear, hats, wooden furniture, pottery, and mats; firewood; schooling and medical care; domestic servants, laundering, and hairdressing; films, eating and drinking out; repairs, improvement and construction of homes; public transport and the operation of own transport.

In all three countries, this local nonfood category has the highest expenditure elasticity. This means that a 10% increase in household income in Sierra Leone will lead to a jump in spending on local nonfarm goods and services equal to 14%, to a 13% increase in the Gusau region of Nigeria, and to a 20% increase in Muda. Thus, we have strong evidence that rural nonfarm goods and services are not inferior, but rather have the potential to grow more rapidly than agricultural itself, providing an expanding share of all rural employment.

Individual components of the nonfarm category have sharply differing expenditure elasticities. The highest elasticities are associated with services. Thus, in Sierra Leone the figure for transport is 1.38 and for personal services and ceremonial outlays, 2.38. By contrast, the elasticity for manufactured products originating from small-scale producers is 0.86. In Gusau and Muda the figures for housing construction and repair are 1.40 and 3.02; and for transportation, 1.67 and 1.48.

Elasticities for specific manufactured goods for Sierra Leone and Bangladesh are shown in Table 10. The Bangladeshi households, at a per capita income of about US$100, are the poorest of the four countries and, presumably, have the smallest budget shares devoted to nonfood items. Both countries have higher income elasticities of demand for rural based production, relative to the products of large-scale urban industry.

Table 9. Rural expenditure elasticities in three countries

Item	Average budget share			Expenditure elasticities		
	Sierra Leone[a]	Nigeria[b]	Malaysia[c]	Sierra Leone[a]	Nigeria[b]	Malaysia[c]
Own food	47	56	27	0.87	0.88	0.37
Local food	21	19	19	1.06	1.09	0.76
Imported food	NA	5	21	-	1.07	0.65
Local nonfood	9	9	18	1.40	1.34	2.05
Imported nonfood	NA	11	15	-	1.16	1.66

[a]Sierra Leone: a national sample 1974, N = 203. [b]Nigeria: the Gusau region 1977, N = 321. [c]Malaysia: the Muda region 1973, N = 839.
Sources: Sierra Leone: King and Byerlee (1978), p. 204; Nigeria and Malaysia: Hazell and Roell (1983), p. 28.

Growth in farm and nonfarm rural employment has followed the pattern predicted by these expenditure elasticities. However, the composition of nonfarm activities likely differ from that suggested by the elasticity coefficients. Expenditures on rural manufacturers will be lower and expenditures on services (particularly trade and transportation) will be higher than predicted.

Beginning with manufacturers, the initial range of a rurally supplied good will be larger or smaller, depending upon craft traditions and the entrepreneurial endowment (e.g., it tends to be larger in Asia than in Africa). But in all countries, as per capita income rises, there is a shift in location from village to regional town and metropolitan area. Although the rural producer has an advantage in less expensive labour and premises, improving rural roads progressively diminish the natural protection he enjoys against urban

Table 10. Expenditure elasticities of rural households for various small and large enterprise products, Sierra Leone and Bangladesh.

Products	Sierra Leone[a]	Bangladesh[b]
Food		
Bread - small	+0.69	+1.14*[c]
Clothing		
Dresses and pants		
Tailoring, small	+0.72*	+0.96**
Clothing, large	+0.59	d
Imported	+1.49	+0.29
Lungi		
Small	d	+1.61*
Large	d	+1.00*
Sari		
Small	d	+2.00*
Large	d	+0.63**
Synthetic, large	d	+1.74*
Wood		
Furniture, small	+1.61*	+2.00*
Metal		
Agricultural tools and utensils		
Small	+0.50	+1.06*
Large	+0.89	+1.29*
All small-scale industry[e]	+0.76*	d
All large-scale industry[e]	+0.33	d

[a]In Sierra Leone, data (1974) from 203 rural households were fitted into a modified form of a ratio semilog inverse expenditure function. [b]In Bangladesh, data (1980) from 444 rural households were fitted into a semilog expenditure function with the values in table estimated at mean expenditure levels. [c]* estimated coefficients significant at 1% level; ** estimated coefficients significant at 5% level. [d]Data not available. [e]From King and Byerlee (1978).
Sources: Sierra Leone: King and Byerlee (1977); Bangladesh: BIDS (1981).

towns where the larger markets promise higher returns; and greater availability of more skilled labour and of cheaper, more diverse raw materials. Production in the towns, while carried out in units four or five times the size of the rural producer, is still comparatively small-scale and labour intensive.

To the extent large-scale public investment builds up the infrastructure of regional towns, many entrepreneurs will locate here and the output is not lost to the larger rural economy. But to the extent entrepreneurs migrate to the urban areas and urban based substitute goods--plastic utensils, synthetic textiles--replace traditional products, the demand for rurally-produced manufactured good will fall. Because these changes--along with other shifts in taste and relative prices--occur over time, they are not picked up in cross-section expenditure surveys. Hence, the latter's expenditure coefficients are an overestimate.

Expenditure studies may also underestimate nonfarm transport and trading activities, since most are embedded in the price of the consumer goods. If there is a shifting away from village-produced goods to more distant sources, the share of marketing services will rise. Hence, inferences from household expenditure patterns may underestimate the growth in aggregate rural nonfarm services.

Forward and backward linkages

The two remaining, smaller categories of expenditures pertaining to nonfarm activities are production outlays on farm inputs (backward linkage) and expenditures on processing and marketing of agricultural output from the farm (forward linkage). Production inputs (e.g., cement for irrigation works; fertilizer, typically the largest single input expenditure; other agricultural chemicals; and four-wheel tractors) do not originate in the rural economy. Also, agricultural products are partially processed in urban areas. One of the few studies that netted out intersectoral purchases (Bell, Hazell, and Slade, 1982) for Muda found that one-third of the incremental income was due to backward and forward linkages, whereas two-thirds was attributable to consumption expenditures.

While localized forward linkages give rise to considerably more value-added than the comparable agricultural inputs[8], the latter--particularly farm equipment--play a unique role in their potential impact on agricultural productivity. Other nonfarm activities such as trading and transport stimulate farm output by reducing marketing costs, which leads to an outward shift in farm level demand. On the other hand, farm equipment inputs directly increase yield per acre and output per person.

There are two components to the nonfarm sector's productivity contribution to agriculture. The first is related to the rural farm equipment industry's capacity for idiosyncratic design adaptation. In the animal draft farming sector of many Asian, African, and Latin American countries; three or four types of ploughs are used, both for breaking the soil and for secondary tillage. In Taiwan, local blacksmiths have provided farmers with a wide array of cheap, highly-specialized implements. Primary tillage to one side, one of eight secondary tillage implements is the harrow. There are 11 kinds of harrows: the comb harrow, three knife-tooth harrows (standard, bent frame, flexible tooth), two spike harrows, the bamboo harrow, the pulverising roller, the stone roller, the tyned tiller, and disc harrow. The standard knife-tooth harrow has 12 regional variants; width, length, material, number of teeth, shape of tooth blade, and method of affixing teeth are adapted to local topography, field size, soil structure, and available construction materials.

Idiosyncratic design adaptation enables farmers to complete a task--in this case secondary tillage--more quickly (higher labour productivity) and more effectively (higher land productivity). More dramatic, better known examples of idiosyncratic design adaptation include India's portable irrigation

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[8]A good overview of specific production inputs and processing activities is available for Thailand (World Bank, 1983). The share of all manufacturing value-added deriving from rice milling, rubber processing, cassava chipping, tobacco curing, and fruit canning that takes place in rural areas is many times larger than that of farm equipment and animal feed. For a more general treatment of the relative size of forward and backward linkages over the course of economic development, see Simantov (1967).

pump, based on vertical high-speed diesel engines made in small engineering workshops; and Thailand's Prapradaeng power tiller[9].

These last two examples also illustrate the second way that rural farm equipment producers raise agricultural productivity--by supplying inexpensive partial mechanization inputs which break labour bottlenecks and thereby pave the way to higher cropping intensity. Additional examples include small electric or gasoline pumps, small motors attached to threshers and winowers, and backpack sprayers which increase output per acre per year and labour income through higher utilization of manpower over the entire year.

In summary, the rural nonfarm sector stimulates agricultural output in three ways: through substantial income effects on food expenditures, through reduction of marketing costs, and through the productivity contribution of localized farm equipment manufacturers.

SUPPLY RESPONSE TO INCREASING DEMAND

The extent to which the increase in demand described above will translate into an expansion in rural nonfarm output depends on the supply response. In the short-run, this depends on the amount and source of the excess capacity of existing firms. In the long-run, the key determinant is the barriers constraining the expansion of existing firms or the entry of new firms. The current and prospective relative efficiency of substitute goods from sources external to the rural area is also of critical importance as discussed above.

Short-run excess capacity

With respect to the short-run supply response, available evidence indicates that there is substantial excess capacity among the rural nonfarm enterprises in many developing countries. Excess capacity measures are difficult to precisely quantify and studies in developing countries are particularly sparse, usually limited to larger urban firms (see Bautista, 1981, for a discussion of

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[9]The case of the power tiller in Thailand is instructive. Japanese power tillers for paddy cultivation had not been widely adopted owing to high purchase price. A low-cost adaptation, developed by IRRI in the Philippines, was introduced in the late 1960s; it did not succeed. The Prapradaeng tiller was developed locally and improved through a prolonged iteration between local farm users and the equipment producers--the forcing house of successful appropriate technology--and is now manufactured by more than 40 small firms.

these studies). However, surveys of small rural manufacturing firms conducted by Michigan State University and host country researchers in five countries have generated some information on many facets of their operation, including excess capacity (Leidholm and Mead, 1986; Kilby and D'Zmura, 1985). On the basis of the responses of rural entrepreneurs to the question of how many additional hours they would operate their existing firms if there were no demand or materials constraints, the estimates of overall excess capacity ranged from 18% in Egypt, 24% in Honduras, 35% in Jamaica, 37% in Sierra Leone, and 42% for rural manufacturing firms in Bangladesh (Liedholm and Mead, 1986). Excess capacity varied between industries and by location in each country, but rarely declined below 10%; virtually no small rural firms in these countries operated on more than a single shift.

Demand factors

What was the primary source of this excess capacity? The limited survey evidence indicated that rural entrepreneurs perceived that demand factors were more important than supply ones. In Jamaica and Sierra Leone, the only two countries in which the question was asked, over 80% of the entrepreneurs reported that the lack of demand was the primary source of their excess capacity. In such cases, demand-stimulating policies play a central role.

Supply side

Raw materials and working capital. On the supply side, lack of raw materials and working capital were the most frequently cited sources of excess capacity. A common cause of raw material shortage for small rural firms is the country's foreign exchange regime, which discriminates against the small producer (Haggblade, Liedholm, and Mead, 1986). The other major factor cited was a lack of working capital, generally the largest component of total capital for small enterprises. These shortages often occur at intervals over the course of the year. The primary external source of funds is advance payments by customers, rather than commercial banks or even the informal market (Kilby, Liedholm and Meyer, 1984). Although internal cash flow generated by the firm tends to predominate, funds also arise from other rural household enterprises[10]. In contrast to specialized farming households, the

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[10]For a discussion of the new agricultural household models, which include multiple activities but also the integration of consumption and production activities, see Singh, Squire and Strauss (1986).

pattern of cash flows for rural households that also undertake nonfarm activities is different. This facilitates internal cross finance that reduces recourse to external borrowing. Meyer and Alicbusan's (1984) study of the cash flow of a sample of Thai rural households revealed that nonborrowing households were more heavily engaged in nonfarm activities than borrowing households.

Labour. On the other hand, labour is generally not a binding short-run constraint for rural nonfarm activities. The dominance of the seasonal agricultural demand for labour is of key importance in understanding rural labour activity. Yet, one must be careful not to treat farm and nonfarm employment as separate entities. Policy interventions must consider the very close, often symbiotic, relationship between these two labour categories over the agricultural cycle. The empirical evidence indicates that in most countries nonfarm activities continue throughout the year. Thus, nonfarm employment competes somewhat with agricultural employment during peak farm labour demand periods. However, since over the seasons, farm and nonfarm employment move in opposite directions, they are highly complementary. For instance, data from Sierra Leone (Byerlee, *et. al.*, 1977) reveal that during the slack agricultural months nonfarm labour use is nine times the use in peak agricultural periods. The fluidity of labour between several activities on a seasonal basis serves to reduce overall variability of labour use over the year. For example, in a study of four regions of Thailand, the coefficient of variation (CV) in rural households' use of farm labour over the year was 0.56, but declined to 0.21 when nonfarm activities were included (Narongchai *et al., 1983).* Similar reductions in the CV are found in studies conducted in Sierra Leone, Northern Nigeria and Malaysia (Barnum and Squire, 1981). In summary, the magnitude and causes of the excess capacity observed in most rural nonfarm activities indicates that a significant short-run supply response is likely.

Long-run barriers to entry

In the long run, the barriers to entry can influence the supply response of rural nonfarm enterprises--particularly capital, skill, and entrepreneurial constraints.

Initial capital constraint

How significant are the capital constraints? The empirical evidence indicates that such barriers for most rural small enterprises are low, but not insignificant in some instances. The initial capital requirements reported in most studies of rural manufacturing enterprises appear quite small, ranging from US$50 in rural Sierra Leone, US$839 in rural Bangladesh, to US$1,066 in rural Jamaica (Liedholm and Mead, 1986). However, in relation to average incomes the capital barrier is quite large in some countries. For example, in Bangladesh, the US$839 overall initial capital requirement is almost six times the country's per capita income. These figures also mask the wide variations in initial capital requirement by type of small enterprise. In Bangladesh, new jute baling firms required over US$13,000 in initial capital, while only US$6 was required for new rural mattress enterprises (B.I.D.S., 1981). There is also limited evidence that these barriers are higher for manufacturing than for most unskilled service and petty trade activities. For instance, Fisseha's (1986) recent survey of forest based activities in rural Zambia reveals that the initial capital requirements for the major manufacturing activities were five times those for the service-related ones. The funds needed to either create or expand these enterprises are overwhelmingly obtained from personal savings, gifts, and informal loans from family or relatives. Studies from Sierra Leone, Haiti, Bangladesh, and Jamaica indicate that over 80% of the initial capital for rural manufacturing firms come from these internal sources, while about 90% of the funds used for expansion are reinvested profits. They have little access to formal credit sources, partly traceable to policy discrimination against small firms (Haggblade, Liedholm, and Mead, 1986), and rarely do they use the informal credit market. Thus, lack of capital appears to act as a partial barrier to the entry of new firms into some types of rural nonfarm enterprises. However, generally these barriers are not unduly high, so they should not seriously constrain the expansion of these activities.

Human capital constraint

What of the human capital constraints that might limit an expansion of rural nonfarm firms? Evidence from various small rural enterprise surveys indicates that formal educational barriers to entry are low. However, in many countries, the informal apprenticeship system or on-the-job training play a key role in skill formation. The proportion of rural manufacturing proprietors who were apprentices or on-the-job trainees was 90% in Sierra Leone, 75% in Jamaica, 52% in Honduras, and 50% in Egypt (Liedholm and Mead, 1986). The period of informal training which defines the length of the gestation period for new capacity varies markedly by type of enterprise. For example, in Sierra Leone, it varies from one year in gara (tie-dying), to four years in metal working; while in Egypt the training period ranged from one month in hat-making to three years in shoe-making (Davies, *et. al.*, 1984). In general training is a more significant entry barrier in manufacturing than in petty trades or simple service activities. Fisseha (1986) reports that in rural Zambia only 16% of the service and vending entrepreneurs had training, compared to 82% for manufacturing entrepreneurs.

In summary, all the ingredients are present for a highly competitive system that responds quickly to changes in consumer demand. The expansion sequence is as follows: an increase in demand leads to a price rise which in turn widens entrepreneurial earnings, thereby attracting a larger supply of apprentices and soon-to-be independent producers. Internal sources provide the capital to expand capacity, which drives down prices and profit.

GROWTH IN RURAL NONFARM ACTIVITIES

Has rural nonfarm activity, in fact, been increasing over time? Aggregate statistics indicate that it generally has. Anderson and Leiserson's (1980) analysis of ILO secondary data, showed that between 1959 and 1970, the employed rural labour force increased faster than the agricultural labour force in all regions except Latin America. Specific data for nine countries reported by Chuta and Liedholm (1979) reveal that the percentage of the labour force engaged in nonfarm work has risen in all of them. They also report the following annual growth rates in nonfarm rural employment: Korea 1960-74 at 3.2%, Taiwan 1955-66 at 9.4%, Kenya 1969-75 at 8.8%, Mexico 1960-70 at 5.6%, Iran 1956-72 at 4.8% and Indonesia 1961-71 at 5.5%.

There are important variations in the growth rates by type and size of enterprise. For example, time-series data on differential rural growth rates by firm size are sparse, but limited information on rural industrial growth rates are now available for firms employing from 1 to 50 persons in India (1961-71) and Sierra Leone (1974-80) (Liedholm and Mead, 1986). These data indicate a direct relationship between the growth rates and firm size. For example, in both countries, the growth in the number of rural industrial firms is highest in the 10 to 49 employee size category and lowest in the one-person firm category. Indeed, in Sierra Leone, the number of one-person rural industrial firms actually declined during the period covered by the study. Such findings tend to reinforce Anderson's (1982) conclusion, that household manufacturing for the country as a whole "tends to decline first in relative and then in absolute terms as industrialization proceeds." Moreover, the growth rates were higher the larger the size of locality and thus, reflect the shift to provincial towns noted above.

CONCLUSION

Nonfarm activities productively absorb a large quantity of rural labour and provide a major source of income to a majority of rural households. Because they are the source of a particularly large share of sustenance to the rural poor, they have a substantial impact on reducing income inequality. An exclusive focus on land reform as solution to rural poverty is mistaken.

Finally, nonfarm activities are not only efficient contributors to GDP, but they stimulate agricultural growth through effects on income, farm productivity, and marketing costs.

Differing public policies will result in a larger or smaller rural nonfarm economy. The redirection of large-scale public expenditures towards the development of infrastructure in rural towns is one potent intervention available and is highly desirable on other grounds. A second area is the creation of a general policy environment that is at least neural with respect to the size of enterprises (Haggblade, Liedholm, and Mead, 1986). For instance, implicit tariffs on tools and equipment, raw materials, and spare parts should not be higher for smaller firms than for larger firms as is true in many countries. In addition, given the strong linkages, policies aimed at increasing agricultural output are relevant to raising nonfarm output and employment. At the project level, the new lending modalities for channeling working capital to micro-enterprises should be pursued (Kilby and D'Zmura, 1985). Finally, the strength of the nonfarm sector depends upon the infusion of the new technical knowledge. Research and development expenditures need to be aimed at design upgrading of farm equipment, transportation vehicles, and traditional consumer products; best-practice surveys and adaptive research are needed to improve existing artisan production processes. In all probability these steps will only be taken when those in power are more fully informed of the size and potential contribution of the rural nonfarm sector and then are willing to commit themselves to the potentially hazardous task of mobilizing new constituencies and placating the old.

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COMMUNAL MAIZE PRODUCTION, STORAGE, AND MARKETING IN ZIMBABWE: IMPLICATIONS FOR POLICY MAKERS

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THE GROWTH OF SMALLHOLDER MAIZE PRODUCTION IN ZIMBABWE (1979-1985): IMPLICATIONS FOR FOOD SECURITY

D.D. Rohrbach[1]

INTRODUCTION

In 1980, over 40% of the population of Sub-Saharan Africa suffered from calorie deficiencies, as indicated by consumption levels below 90% of FAO/WHO requirements. Consumption levels below 80% of FAO/WHO requirements threatened one-quarter of all Africans with stunted growth and serious health problems[2] (World Bank, 1986:17). Yet per capita food production further declined in two-thirds of the Sub-Saharan countries over the next five years (FAO, 1985a). African cereal grain imports increased to record levels (FAO, 1985b). By 1987, three-quarters of the countries in Sub-Saharan Africa required concessionary food aid. In the SADCC region, every country except Zimbabwe required net food imports (USDA, 1987).

Zimbabwe's recent cereal production record stands in sharp contrast to these African trends. Between 1979 and 1985, Zimbabwe registered an 80% increase in per capita cereal production[2]. Production of maize, the country's basic staple which provides 70% of the cereal calories and 45% of all calories in the average Zimbabwe diet (FAO, 19[illegible]), more than doubled. By the end of 1986, Zimbabwe had amassed a record maize stock of almost 2 million mt--20% larger than the previous year's total domestic maize consumption. Although Zimbabwe initiated a large domestic food aid programme in response to widespread drought during the 1986-87 season, the country could still export 500,000 mt of maize to other countries in the region.

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[2]CSO (1985a) and CSO (1986b) provide two basic listings of Zimbabwe agricultural statistics employed herein.

Remarkably, smallholders contributed most of Zimbabwe's post-1979 maize production gains (Figure 1)[3]. During the 1970's, smallholder crop production was broadly characterized by low productivity and slow growth. Maize production, the smallholder sector's principal farm enterprise, was stagnant. Yields averaged one-seventh those obtained by the commercial farm sector (Figure 2). While planting two-thirds of the country's maize area, smallholders harvested only one-quarter of the total maize crop (Figure 3). Smallholder maize sales accounted for less than 5% of total deliveries to national markets (Figure 4). These farmers made up 95% of the producers, yet earned less than 10% of the agricultural income derived from crop and livestock sales through the marketing authorities (CSO, 1986b).

During the six years from 1979 to 1985, the smallholder maize subsector rapidly expanded. Maize production more than tripled as area increased by 90% and yields roughly doubled. By 1985, smallholders produced over one-half the country's maize supply. Sixty percent of the production gains were delivered to national markets. As a result, the smallholder contribution to Grain Marketing Board (GMB) intake rose to over one-third of total maize deliveries. These successes led the government to project a 7% annual growth rate in smallholder harvests over the 1986 to 1990 period (Zimbabwe Government, 1986).

This paper identifies why smallholder maize production and market sales increased so rapidly after 1979 and examines the implications of these gains for national food security (see Rohrbach 1987, 1988 for more details). The analysis is based on a review of aggregate smallholder production and market data and 13 months of farm-level survey work in two smallholder farming regions. One survey region, Mangwende, situated in Mashonaland East Province, was chosen to represent Zimbabwe's high-potential farming regions. The second region, Chibi, in Masvingo Province, was chosen to represent a maize producing region in the low-potential farming regions.

This paper first reviews the major factors underlying the smallholder maize production and market gains. Second, the relative response of smallholders to price, institutional, and technological interventions is assessed.

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[3]In 1983, Zimbabwe's agricultural sector encompassed roughly 5,500 large-scale commercial farmers, 8,600 small-scale commercial farmers, and 800,000 communal or smallholder farmers (CSO, 1985a). By 1986, the nascent resettlement areas held approximately 31,600 farmers (MFEDP, 1986). Over 90% of Zimbabwe's maize is produced by large-scale commercial and communal farmers.

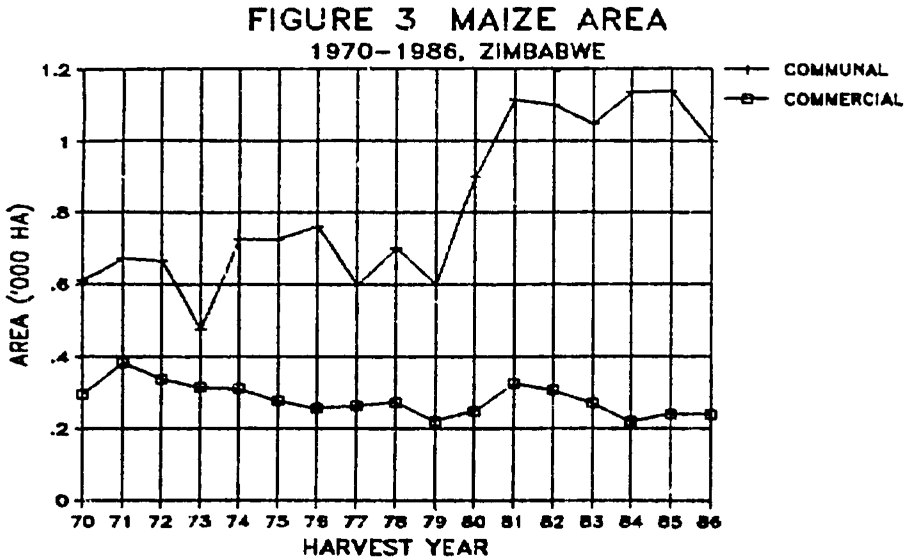


FIGURE 3 MAIZE AREA
1970–1986, ZIMBABWE
COMMUNAL
COMMERCIAL
AREA ('000 HA)
1.2
1
.8
.6
.4
.2
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
HARVEST YEAR

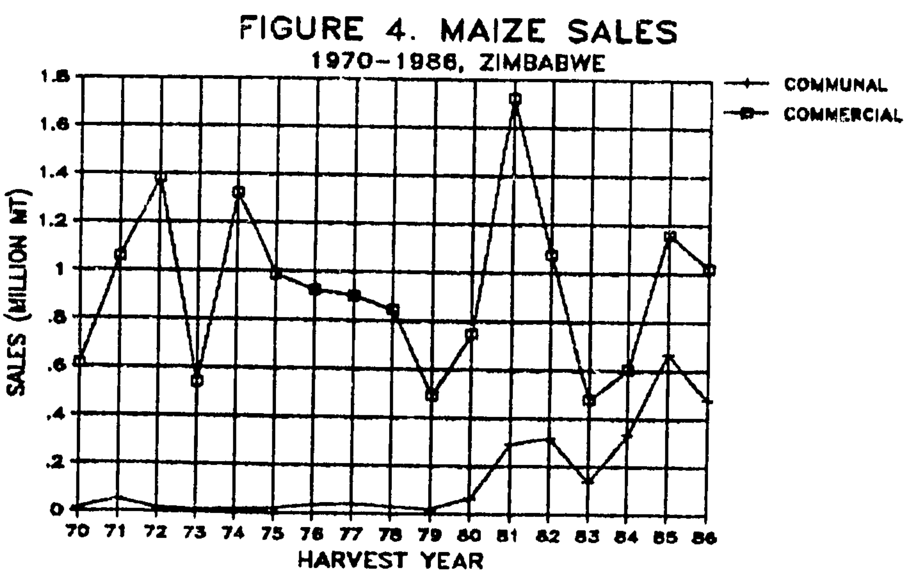


FIGURE 4. MAIZE SALES
1970–1986, ZIMBABWE
COMMUNAL
COMMERCIAL
SALES (MILLION MT)
1.8
1.6
1.4
1.2
1
.8
.6
.4
.2
0
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
HARVEST YEAR

FIGURE 1. MAIZE PRODUCTION

1970–1986, ZIMBABWE

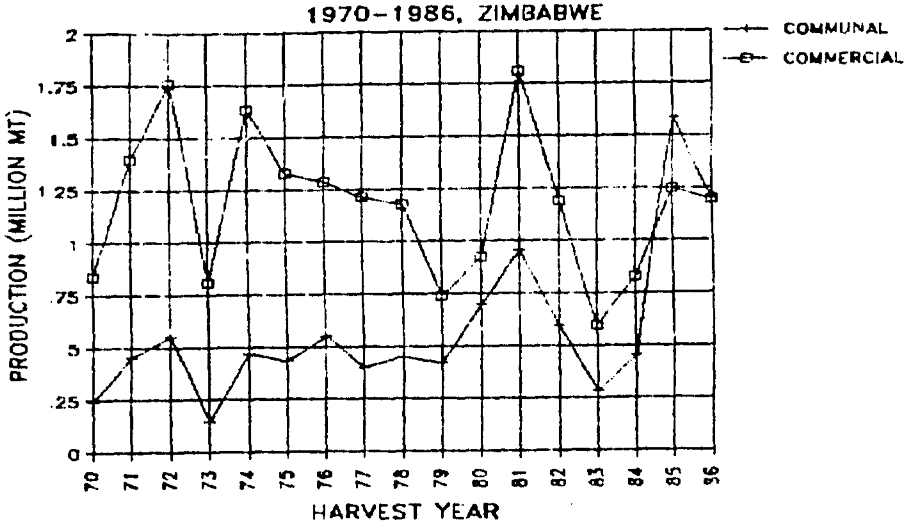
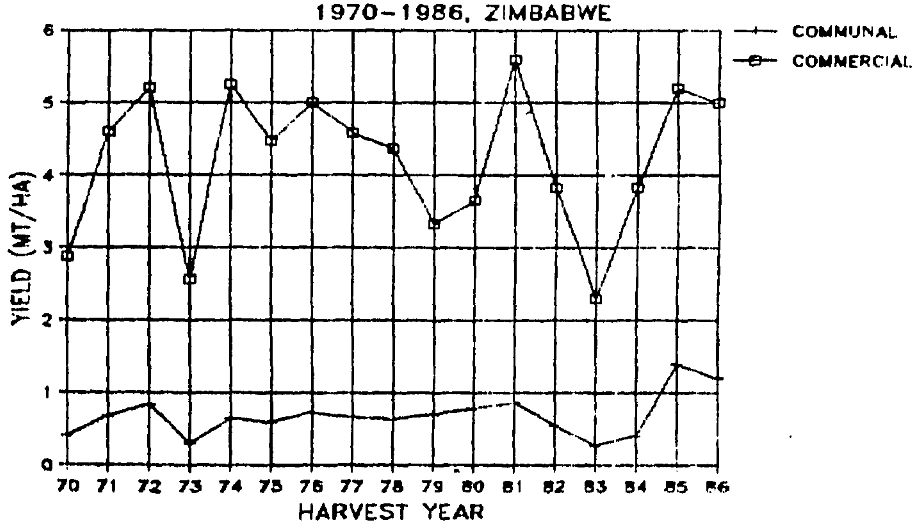


FIGURE 2. MAIZE YIELDS

1970–1986, ZIMBABWE



Third, the breadth of participation in the smallholder production and sales trends is examined and the principal characteristics distinguishing major participants are cited. Fourth, the constraints and opportunities for replicating these gains across alternative smallholder crops and across countries in the SADCC region are briefly noted. The discussion concludes with a comment on the implications of the growth in smallholder production for Zimbabwe's food security.

CAUSES OF SMALLHOLDER MAIZE PRODUCTION GROWTH

The growth of smallholder maize production between 1979 and 1985 can be largely attributed to five factors: the ending of the independence war, the expansion of product and input market infrastructure, the availability of a proven set of maize technologies, the establishment of a smallholder credit programme, and the sharp 1980 and 1981 increase in maize producer prices.

The ending of the war

The independence struggle in Zimbabwe widely disrupted smallholder agriculture, particularly during the mid-to-late 1970s. As violence in the rural areas escalated, agricultural support institutions provided to smallholders were destroyed or abandoned. Extension workers were withdrawn, dip tanks were razed, and isolated government buildings were demolished. More importantly, communal farmers abandoned distant fields, fewer new holdings were created, and many farmers left their holdings altogether. After independence, the government estimated up to one-third of the smallholder sector required resettlement. While survey data indicate this figure may be high, a substantial loss of production likely occurred. Aggregate estimates of communal production during this period do not fully reflect this loss, possibly because the extension workers responsible for making these estimates were withdrawn from many areas.

At the end of the war, the area in smallholder maize increased sharply. This resulted from both a sudden increase in the number of smallholder farmers and an expansion of the area planted by those who had continued farming during the war. Survey evidence from Mangwende and Chibi reveals many younger families took advantage of the peace to establish new holdings. Older households replanted abandoned fields and further expanded their holdings (Table 1). The area of all major crops, except bulrush millet, increased, but the largest gains occurred in maize area.

Expansion of market infrastructure

After independence, the limited input and product market infrastructure serving the smallholder sector rapidly expanded. Many shopkeepers in the communal areas began stocking seed, fertilizer, insecticide, and farm equipment. Stores based in urban centres established rural outlets. The fertiliser and agrochemical companies began promoting agricultural inputs with village based sales and demonstration trials. The growth of input markets was particularly strong in high-potential regions such as Mangwende.

The GMB was established in 1931 with sole responsibility for buying all major grain and oilseed crops sold beyond district borders. Until 1980, this institution concentrated its activities in the large farm sector. Thereafter, the GMB invested heavily in establishing depots and collection points in the smallholder farming areas (Table 2). Concurrently, private sector investors established GMB authorised approved buyer facilities and farm-to-market transport operations. Small shopkeepers registered with the GMB to purchase crops and smallholders, themselves, bought lorries. In Mangwende, for example, a GMB depot had been established in 1977, but the first approved buyer serving survey farmers set up operations in 1982. A series of collection points were established by the GMB in 1985. The number of locally based transporters serving survey respondents increased from two in 1980 to 18 in 1985. In Chibi, two GMB collection points were established in 1985. An approved buyer started operations in 1986. However, crop sales were insufficient to stimulate the establishment of locally based transport services.

The expansion of input markets reduced the cost of input transport and increased input availability. The expansion of product market facilities reduced farm-to-market transport costs, thus raising farm level prices. Together, these interventions increased the net returns to maize production and the incentive of producers to expand their maize hectarage. Greater quantities of inputs were purchased and many smallholder began selling maize on the national market for the first time. For example, the proportion of Mangwende farmers selling maize to the GMB increased from 22% in 1980 to 80% in 1985. In Chibi, 85% of the farmers selling crops to the GMB, made such sales for the first time 1985.

Table 1. Sources of increase in maize area in Mangwende and Chibi, 1974-1975 to 1985-86, Zimbabwe.

	Mangwende		Chibi	
Proportion of maize area gain resulting from:	1975-1981	1981-86	1975-81	1981-86
Increase in number of farmers (%)	71	40	86	69
Increase in area per existing farmer (%)	29	60	14	31

Source: Mangwende and Chibi survey.

Table 2. Expansion of GMB buying points, 1975-86, Zimbabwe.

	1975	1980	1981	1982	1983	1984	1985	1986
Total depots	32	34	37	41	43	44	45	51
Communal depots	1	3	6	10	12	13	14	20
Collection points	0	0	0	0	0	0	135	57

Source: GMB

The availability of improved technology

While the expansion of market infrastructure improved the economic returns to all major smallholder crops, only maize production increased significantly[3]. The historical development of improved maize production technologies gave this crop a competitive advantage over alternative smallholder enterprises. Before 1980, most agricultural research had been geared to the needs of the large-scale commercial sector. Yet, some results were also applicable to smallholders. Decades of breeding research produced hybrids adapted broadly to high and low-potential zones. Fertilizer trials provided recommendations roughly attuned to the agroecological conditions of the small farm sector, particularly the higher-rainfall regions.

Between 1979 and 1985, hybrid maize seed sales to the smallholder sector increased roughly fivefold (Table 3). By 1986, roughly 85% of the smallholder maize area was planted with hybrid seed. Smallholders increased their fertilizer purchases for maize by 400% (Table 3). Much of the sharp increase in 1980 input sales resulted from the distribution of free inputs under a one-year refugee resettlement programme. Thereafter, most of the sales gain can be attributed to the expansion of input market infrastructure, improved maize returns, and the establishment of a smallholder credit programme.

The establishment of a smallholder credit programme

Smallholders first gained access to government agricultural credit in 1958, although less than 1% of these farmers received loans. By 1962 only 4,000 short-term loans had been granted, most to small-scale commercial farmers (Johnson, 1964). In 1978, The Agricultural Finance Corporation (AFC), historically a major lending body for large-scale commercial farmers, established a major new small-farm credit programme. By 1985, roughly 10% of smallholders received loans. In the two survey regions covered by this investigation, credit provided the principal basis for fertilizer investments. In Mangwende almost three-quarters of all fertilizer purchased in 1986-87 was bought with credit, though only 37 of the region's farmers received loans. In Chibi, the 5% of the farmers receiving credit purchased almost 90% of the fertilizer applied. In both regions, all loans were granted for maize.

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[3]Smallholder cotton production also increased sharply, though the increase in maize area was five times greater than that to cotton.

Table 3. Hybrid maize seed and fertilizer deliveries to the smallholder sector, 1974-85, Zimbabwe.

Cropping Season	Fertilizer Deliveries (mt)	Seed Deliveries (mt)
1974/75	24,000	2,350
1975/76	19,000	3,950
1976/77	20,000	2,700
1977/78	25,000	3,700
1978/79	25,000	4,250
1979/80	27,000	4,300
1980/81	90,000	9,650
1981/82	96,000	13,950
1982/83	98,000	16,900
1983/84	106,000	17,300
1984/85	127,664	19,500
1985/86	130,000 (est)	20,250 (est)

Source: Windmill (1987); Seed Cooperative (1987)

Producer prices

Between 1979 and 1981, the government increased the real producer price of maize by 80% (Figure 5). The ratio of the producer price to the price of maize fertilizer increased 50% (Figure 6). Maize producer prices doubled relative to consumer prices (Figure 6). After 1981, the real maize price and producer-to-consumer price ratio sharply declined. The maize-to-fertilizer price ratio fell more gradually.

Commercial farmers quickly responded to these price changes. Between 1979 and 1981, the commercial maize area increased by 50%; commercial production more than doubled. When real maize prices began to decline, commercial production similarly fell. Between 1981 and 1985, commercial maize area and production declined by 30%. In contrast, smallholder maize production and sales rose throughout the post-war period. Between 1981 and 1985, when real maize prices were falling, smallholder production increased by 60%.

FIGURE 5. REAL MAIZE PRICE INDEX

1971–1986, ZIMBABWE (1975=100)

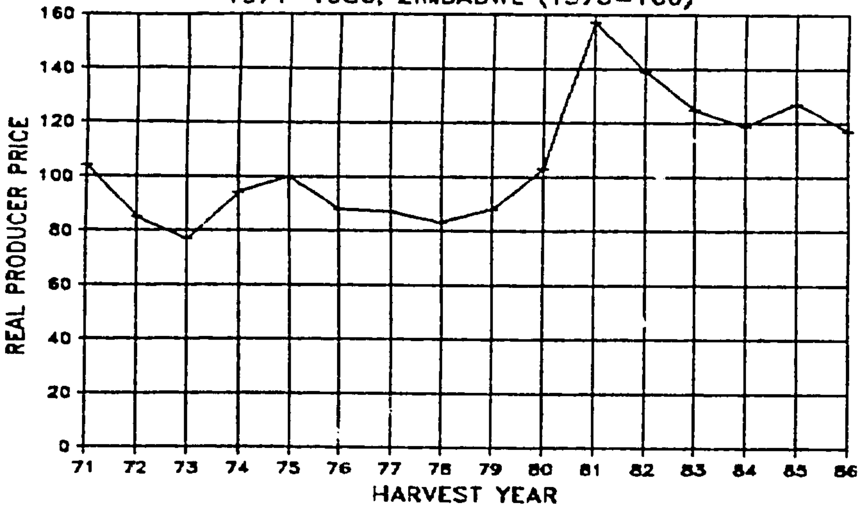
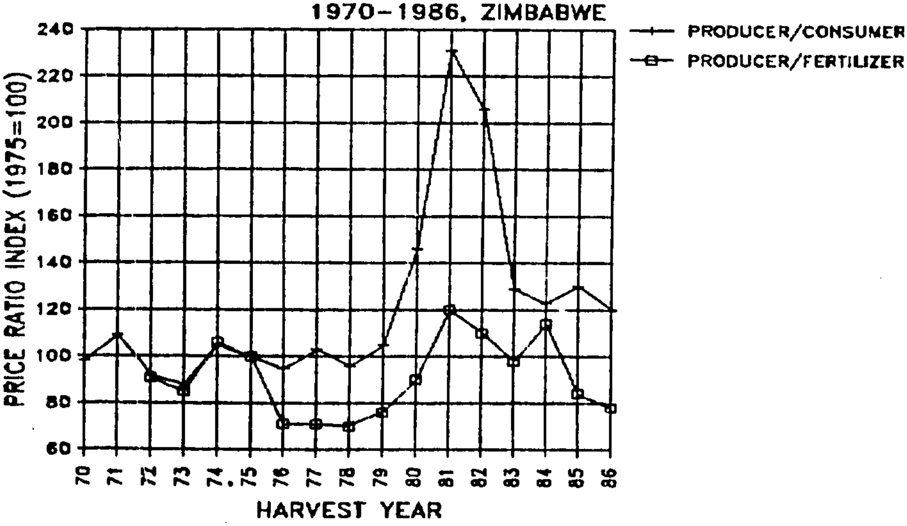


FIGURE 6. RELATIVE MAIZE PRICE INDEX

1970–1986, ZIMBABWE



Smallholder maize sales more than doubled. In both Mangwende and Chibi, the largest increase in market deliveries occurred after 1981. During this period, the expansion in smallholder access to national markets, improved availability of inputs, and growth of agricultural credit offset the impact of the decline in administered prices.

The 1979 to 1981 price gains provided a post-war stimulus to smallholder production. In high-rainfall Mangwende, these gains helped prompt the expansion of market infrastructure and promoted greater use of improved technologies. Yet, infrastructural and institutional changes may, ultimately, have had a much larger impact on producer decision making than the level of administered prices. Before 1980, smallholders remained largely unresponsive to input prices and fluctuations in government guaranteed producer prices. The post-war sales trends in the two survey regions are most closely correlated with the expansion in each area's market infrastructure.

PRICE INCENTIVES, TECHNICAL AND INSTITUTIONAL CHANGE

Theoretical models of supply response emphasize the importance of either price policy and market liberalization, or structural change encompassing the expansion of market infrastructure and improved technology. The World Bank stands prominently as a major advocate of price and market reforms. In a 1984 strategy statement for Africa, the Bank cited price distortions and market inefficiency as the major constraints to agricultural production (World Bank, 1984). The Bank argued for removing administrative controls on input and product prices, encouraging greater private sector involvement in agricultural markets, and the more "businesslike" operation of parastatals. These prescriptions assume the short-run elasticity of aggregate agricultural production is high and technological and infrastructural constraints are not immediately limiting.

Advocates of institutional and technological change (eg., Eicher, 1982, 1986; Delgado and Mellor, 1984) argue that aggregate supply is relatively inelastic. This perspective emphasizes the constraints embodied in limited market infrastructure, the lack of improved location-specific technology, low levels of human capital, and poor institutional management. Adjustments in producer prices will not substantially affect production levels without the removal of these constraints. Relative prices are still viewed as important. However, the effectiveness of price incentives depends on their incidence at the farm level and the capacity of farmers to respond. Without institutional and technological reforms, the impact of price policy will be limited. However, institutional and technological reforms on their own can have a potentially large impact on smallholder production.

Zimbabwe gained independence with a relatively efficient set of market institutions. Maize prices had historically fluctuated between import and export parity. GMB storage losses were less than 1%. The large-scale commercial sector's response to market incentives was strong. In contrast, the responsiveness of small farmers was strikingly weak. The principal reason for this disparity was the concentration of most public sector support in favor of large farmers. Credit, research, and market institutions had largely been built to serve the commercial sector. Major increases in smallholder productivity did not occur until the early 1980s when these institutions and infrastructure were expanded to serve small farmers.

Before 1980, the main smallholder cropping strategy was to produce enough food for family consumption while seeking off-farm employment for cash income. Some farmers adopted improved technologies such as hybrid seed and fertilizer to increase their labour productivity and food supplies. However, they did not invest extensively to produce a maize surplus. Over the 1980 to 1985 period, the smallholder's strategy changed. Following the war, the producer price increase and refugee relief programmes stimulated greater interest in participation in the national market. Yet, longer term production gains can be primarily attributed to infrastructural and institutional improvements. These fostered continuing increases in maize production when the refugee relief programmes had ended and real producer prices had declined.

The largest increases in production occurred in regions where location-specific maize production technologies yielded the highest returns. While higher producer prices and the expansion of market infrastructure improved farm-level prices of most smallholder crops, the largest increases in area and input investment occurred in maize; the crop for which profitable new technologies were readily available. In effect, producer prices offered a necessary, though insufficient means to promote smallholder maize production. Institutional and technological changes were required to make the producer price adjustments effective.

The post-1980 decline in world maize prices now limits Zimbabwe's ability to export grain. The smallholder maize production experience shows that further growth in market deliveries can be stimulated through a variety of non-price interventions. If real prices continue declining, smallholders will still expand their maize production--if provided with additional improvements in production technologies, reductions in transport costs, and improved market access.

DISTRIBUTION OF SMALLHOLDER PRODUCTION GAINS

Data showing the provincial distribution of smallholder maize plantings indicate that small farmers throughout the country have participated in the expansion of maize production--the principal crop grown by roughly 80% of Zimbabwe's smallholders. Extension workers have estimated that maize area gains were registered in every province. These were distributed roughly according to population levels, except in Matabeleland which experienced smaller gains.

Differential levels of participation become evident in the examination of provincial data for maize yields. While yields have increased throughout the country, the largest gains occurred in the higher-rainfall zones. This difference resulted, in part, because the improved maize technologies (particularly fertilizer) were better suited to the higher-rainfall zones. In addition, the survey data reveals a large disparity in institutional support for the high and low-rainfall regions.

The first GMB depot was established in Mangwende in 1977. By 1985, Mangwende survey respondents had gained three approved buyers, a collection point, and a rapidly expanding transport system. Two cooperatives purchased crops between 1981 and 1984, but found they could not compete with the services provided by other buyers. Market operations were relatively efficient. By 1986, 67% of the farmers had participated in AFC credit programmes and 60% had received help from extension agents. Survey farmers could purchase fertilizer from at least five local suppliers and from sales agents of fertilizer companies.

By contrast, Chibi farmers did not have a locally based GMB depot. In 1985, the GMB established two collection points in the region. However, there are still no locally based truckers. By 1986, only 5% of farmers had received credit and only 27% received extension assistance. Only one local retail outlet stocked fertilizer. The differential level and evolution of institutional support in Mangwende and Chibi reinforced initial differences in agroecological potential.

The advantages of high-potential zones are reflected in the regional distribution of growth in maize sales. The one-quarter of the smallholder population based in high-rainfall regions (Natural Region II) accounts for almost 60% of smallholder maize sales when rains are good throughout the country (e.g., 1984-85). When rains are poor (e.g., 1983-84), these farmers account for over 80% of smallholder maize sales.

The survey data reveal that the concentration of maize production and sales within each agroecological zone is as large, if not larger, than that between the different regions. In both Mangwende and Chibi, the top 20%

of producers harvest at least 50% of each region's maize and market at least 55% of all maize sold (Tables 4 and 5). The bottom 40% of Mangwende and Chibi farmers harvest 6-12% of each region's maize. Despite favorable rainfall in Mangwende, 12-24% of these farmers are net maize purchasers.[4] In Chibi, 24% of households are net maize purchasers in good years and 60% stated their need to purchase maize following the 1985-86 drought-affected season.

The combination of aggregate and regional survey information provides a basis for estimating the distribution of maize production and sales across the smallholder sector. The data suggest the top 10% of smallholder producers, concentrated in the nation's high-potential zones, are responsible for over 50% of smallholder maize production and three-quarters of smallholder maize sales. The concentration of production and sales increases in drought years.

These observations indicate that producers facing the smallest food security risks are the greatest beneficiaries of government policy changes and infrastructural investments designed to promote smallholder production. Producers facing frequent or consistent production shortfalls have benefited least. The majority of smallholders still face basic food security constraints. To improve the circumstances of these poorer producers, the government must target future assistance strategies toward resolving the unique constraints facing these farmers.

SMALLHOLDER INVESTMENT PRIORITIES

The reason for the disparity between the top 20% and bottom 40% of producers in each region merits further investigation. Several relationships in the Mangwende and Chibi data suggest these differences are not simply the result of a concentration of resource ownership. Rather, the most productive farmers in each region have explicitly decided to make greater investments in the maize enterprise.

As the war ended, smallholders throughout Zimbabwe expanded their maize area. Many of the largest producers in 1985 had expanded their plantings the most. Part of this gain resulted from reclaiming fields abandoned during the war. These farmers also sought additional allocations from lands previously designated as grazing areas (land in the smallholder farming areas is allocated by regional chiefs, ward councilors, and village headmen).

The better farmers in both Mangwende and Chibi also took greater advantage of the expansion of input markets, and particularly, the availability

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[4]The lower figure corresponds with the exceptionally good 1984-85 season. The higher figure corresponds with the average 1985-86 season.

Table 4. Distribution of maize production in Mangwende and Chibi, 1984-85 and 1985-86 seasons, Zimbabwe

	Proportion of total maize harvest (%)			
	Mangwende		Chibi	
Quintile	1984-5	1985-6	1984-5	1985-6
Top	54	49	54	67
Second	19	21	21	17
Third	15	20	14	9
Fourth	9	7	8	5
Bottom	3	2	4	1

Source: Mangwende and Chibi surveys.

Table 5. Distribution of maize sales in Mangwende and Chibi, 1984-85 and 1985-86 cropping seasons, Zimbabwe.

	Proportion of total maize sales (%)			
	Mangwende		Chibi[a]	
Quintile	1985	1986	1985	1986
Top	54	59	84	100
Second	24	26	15	0
Third	14	12	1	0
Fourth	7	3	0	0
Bottom	0	0	0	0

[a]Drought occurred in Chibi during the 1985-86 season.
Source: Mangwende and Chibi Surveys

of agricultural credit. In Mangwende, loans have been made available to two-thirds of the region's farmers. Yet over the 1984-85 to 1986-87 period, the number of recipients declined. Only 20% of these farmers consistently accepted loans during this period. While some recipients were forced to dropout of the loan programme due to repayment difficulties, others simply declined to accept more credit. Almost 60% of the households which have continued to participate in the loan programme are headed by men who primarily live and work elsewhere. Despite this, these farmers are among Mangwende's top producers. In Chibi, only farmers with the most land in maize have taken agricultural loans. However, this bias may reflect the tendency of credit-granting AFC agents to consider these producers as the best loan risks.

The average Mangwende and Chibi household earns 20-40% of its income from sources other than field crop production, excluding vegetable crops. Forty-four percent of the male household heads in Mangwende and one-third of those in Chibi work off-farm. Yet most of this income is not getting re-invested into crop production, and much of the income earned from crop sales is invested elsewhere. The largest single investment expenditure of most households is school fees. Yet many farmers are also investing in a broad range of consumption items and alternative enterprises including beer, clothes, improved housing, record players, sewing machines, retail shops, and lorries. While most smallholder households face severe resource constraints, greater cash, labour and land resources were rapidly and broadly committed to maize after 1979. The survey evidence indicates that some farmers simply decided to make greater investments in enterprises other than crop production.

REPLICABILITY OF THE MAIZE PRODUCTION GAINS

A key constraint on the replication of Zimbabwe's maize production gains across a broader range of crops is the lack of improved, location-specific technologies. Smallholders have proven their willingness to adopt improved technologies if these are perceived as profitable. The adoption pattern of maize recommendations suggests smallholders have discriminated between technologies yielding higher returns and those offering questionable gains. Hybrid seed has proven its profitability in high and low-rainfall zones. Fertilizer has proven its effectiveness in higher-rainfall regions, though only a small number of farmers are beginning to accept the risks of fertilizer application in low-rainfall zones. Credit recipients have tested insecticide and found the returns to this investment do not justify even the limited cost. In Mangwende and Chibi, farmers only purchase insecticide for maize as required in loan packages. Similarly, Mangwende farmers have tested herbicide in agrochemical company demonstration trials and rejected this technology.

Farmers in Mangwende and Chibi have consistently rejected recommended technologies for sorghum, millet, and groundnuts. Without technological improvements, smallholders will continue to produce these crops primarily for home consumption. Following the incidence of mid season dry spells and drought during four of the first six cropping seasons following independence, extension workers have encouraged farmers in Chibi to reduce their maize production and plant more drought-tolerant crops such as sorghum and millet. Yet, despite the likelihood of drought, Chibi farmers perceive the returns to maize production to be higher than the returns to the recommended alternatives. While they still plant sorghum and millets, acknowledging their relative drought tolerance, maize remains the preferred food and cash enterprise. Until the yields of these alternative crops can be increased, maize will continue to dominate these cropping patterns.

The implications of the maize production and market gains for other countries in the region depend on each nation's farming circumstances. Several factors make the Zimbabwe situation unique. Much of the increase in production, particularly that associated with area gains, resulted from the ending of the war. The resolution of rural instability and violence stimulated a return of refugees to farming, reclamation of fields once abandoned, and expansion of holdings. Second, the new Zimbabwe government initiated a well developed set of agricultural institutions which could be readily expanded to better serve the smallholder. Discrimination against communal agriculture in the past had limited this sector's productivity. Once this discrimination ended, the improved access of smallholders to existing technologies and national markets stimulated immediate gains. If these institutions had to be newly built, the transition would have been substantially slower.

Nevertheless, the Zimbabwe experience highlights a number of important characteristics of a successful smallholder development strategy. It shows the complementary impact of a combined set of agricultural interventions. Maize production grew because available technologies increased the profitability of this enterprise well above most competing crops. Production expanded for the market, not simply when producer prices increased, but particularly when market access improved. The increase in farm-level prices corresponded with a reduction of input costs associated with improved input availability and the attainment of access to credit. Further, the structure of market institutions allowed the private sector, including farmers, to make investments which were complementary to those offered by the government.

FOOD SECURITY IMPLICATIONS

In a paper leading off the 1986 Conference on Food Security on Southern Africa, Rukuni and Eicher (1987) explained that food security requires food availability as well as food access. This distinction is important in judging the gains Zimbabwe has achieved by tripling smallholder maize production. The country and the smallholder sector as a whole have clearly benefited from both the increase in smallholder productivity and the associated growth of national maize stocks. The nation's food security has improved. Yet this analysis highlights the difference between increasing average per capita food supplies, or food stocks, and the more difficult task of improving the productivity and consumption levels of those households facing the greatest food security risks.

The largest gains in production and largest contributions to national maize stocks were achieved by those smallholders facing the lowest risks of encountering consumption deficits. The food insecure have benefited from the expansion of support for smallholder agriculture. The widespread dissemination of hybrid maize seed has lifted these farmers' yields. The rise in productivity of the larger producers has helped reduce local maize prices, particularly in drought years. The growth of smallholder maize production has also increased per capita retentions to the levels attained during the mid-1970s. The large maize stocks provide a basis for the more timely, and perhaps more generous, delivery of food aid. Yet, these gains remain small relative to the needs of farmers continuing to face food security risks.

The growth of smallholder maize production provides an example of the advances in smallholder production which can be achieved. To broaden these advances, future agricultural development strategies must increasingly focus on relaxing the constraints faced by different segments of the smallholder population. One of the most severe constraints facing the majority of smallholders situated in Zimbabwe's semi-arid regions is the frequent incidence of drought. While large national maize stocks offer one means to offset these risks, these are costly to maintain. The distribution of food aid is also an expensive undertaking. Additional investments in expanding market infrastructure or agricultural credit will not necessarily benefit these farmers. Instead, they will require further improvement in low-cost agricultural technologies, and most likely, the expansion of income-earning opportunities from sources other than crop production.

The poorer farmers in the high-potential zones require less input-intensive technologies. These farmers can benefit from input recommendations which simply increase returns and productivity above current levels, rather than maximizing production returns. This implies the need to develop distinct low and high-input cost recommendations and place greater emphasis on improving crop management practices. Measures can also be taken to encourage complementary links between farm and non-farm enterprises.

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POLICY IMPLICATIONS OF HOUSEHOLD GRAIN MARKETING AND STORAGE DECISIONS IN ZIMBABWE

J. L. Stanning[1]

INTRODUCTION

The emergence of the communal area farmer as an important provider of marketed surplus (Stanning, 1985; Rohrbach, 1986) has had a broad impact on the grain-marketing system at the national, regional, and household level. First, the shift in supply towards communal producers has made it more difficult for the Grain Marketing Board (GMB) to forecast intake. For example, in 1984-85, maize was imported at higher landed cost than the local selling price, because of a forecast shortfall. As it turned out, stocks would have been sufficient as intake was around 50% greater than predicted. While output in both commercial and communal areas exceeded early projection; communal projection was particularly low, relative to actual supply. National forecasts have improved in the last two seasons, but better informed estimates of on-farm retentions, including local sales, are crucial in developing a good forecasting model.

Second, in response to increased communal production and government's rural development policy, the GMB expanded services to rural producers--many of whom market small quantities of grain (Zimbabwe Government, GMB, 1987, Table 1.5). This resulted in operational difficulties and increased the unit cost of procuring grain. To assist communal farmers in communal areas located far from depots, a system of collection points was instituted in 1985-86. Government's ultimate objective, as stated in the *Transitional National Development Plan*, is to locate collection points within 10 km of every farmer (Zimbabwe Government, 1982).

Third, increased grain surpluses and government grain policy have had an impact on the size, composition, and seasonality of demand for grains in rural areas.

Finally, it is important to consider not only the impact of communal area surpluses on the grain-marketing system, but also the impact of government policy on the various segments of the communal sector. To date, Zimbabwe's basic policy objective of growth with equity has been largely seen as a mat-

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ter of redressing the gross imbalance between urban and rural sectors, on the one hand, and the commercial and peasant sectors on the other hand--by emphasising rural development and land resettlement schemes (Zimbabwe Government, 1986). Little attention has focussed on the possibility of inequalities in the distribution of the benefits of development within the rural areas. Yet, results reported in this paper indicate quite marked inequalities within the communal areas. This suggests that the good aggregate performance of communal producers leaves little room for complacency in seeking effective ways of meeting government's central objective of raising the living standards in the rural peasant sector.

This paper focuses on two related issues, the nature and seasonality of farm household grain transactions and the nature and seasonality of farm household income sources to assess:

- the basis for improved national forecasts of grain deliveries;
- marketing activities and market access within communal areas;
- factors influencing the demand for grain in rural areas; and
- distributional aspects of government grain policies.

BACKGROUND[2]

The data base

This analysis draws on part of a larger data base compiled for a study of factors influencing the storage, marketing, and consumption of grains at both the regional and household level in Zimbabwe's communal areas. The complete data base includes secondary time-series data on production and official marketings for all districts in Zimbabwe and survey data from farm households in different types of producing areas. The fieldwork locations are Hurungwe District, a grain surplus region 260 km northwest of Harare; Binga District, located southeast of Lake Kariba, generally a grain deficit area; and Bushu Communal Land, 95 km west of Harare, which provides a modest grain surplus in some years, but also operates under the constraint of high population pressure on land resources.

Farm household surveys were carried out monthly from May 1985 to July 1987 to collect information on household grain flows and storage patterns and related variables such as household characteristics, resources, and income flows.

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[2]A more detailed description of survey methodology is to be found in Stanning, 1986.

This paper discusses only the results from field surveys conducted in Hurungwe District. The significance of this particular fieldwork area is its location in Mashonaland West which, as a province, dominates communal sector per capita maize output and per capita official marketings (Stanning, 1986). Hurungwe is the most populous and productive communal district in this province. Over the past six years (1981-82 to 1986-87), maize purchases have increased at an average rate of around 30% (Table 1).

Survey methodology in Hurungwe District

Two-stage, stratified random sampling was used to select representative farm households to participate in the survey. First, extension-worker areas in Hurungwe District were stratified into three categories according to whether farmers in those areas had good, moderate, or poor access to market.

Table 1. Quantity of grains purchased by the Grain Marketing Board from Hurungwe District, 1974-75 - 1986-87, Zimbabwe (mt).

Year	Maize	Sorghum	Rapoko[a]
1977-78	7,959	2.0	a
1978-79	7,922	4.4	a
1979-80	5,734	16.6	a
1980-81	8,628	18.5	a
1981-82	33,534	12.8	a
1982-83	38,050	21.4	a
1983-84	47,498	32.2	a
1984-85	65,231	153.3	6.3
1985-86	76,299	314.6	159.8
1986-87	96,392	206.0	27.6

[a]Prior to 1984-85, the GMB did not purchase rapoko.

Source: Computed by author from district totals derived from the GMB's annual record of quantities purchased from communal farmers, communal co-operatives, and approved buyers.

Second, fieldwork areas were selected from each category. Finally, cultivator lists, compiled by Agritex, were used to draw a random sample of households from each location. The sample area in Hurungwe covers a diversity of natural regions, ranging from a moderately high-rainfall region in the northeast centered around Chisape to a low-rainfall communal region around Fureche.

Characteristics of sample households in Hurungwe District

In Hurungwe District, sample households average 7-8 persons per household with more than 50% composed of children under 16 years (Table 2). Just under one-third do not own cattle which is probably a smaller proportion than reported for other communal areas (Rukuni, 1985). Hurungwe sample farmers have relatively favourable access to land with an average land holding of 3.9 ha. Maize is the dominant crop grown; serving as the main staple as well as an important cash crop. Maize's importance as a cash crop is probably related to its lower labour and cash input requirements, relative to alternatives such as cotton and oilseeds. The proportion of area under other grains such as sorghum and millets is extremely small. Cotton is the most important nongrain crop grown, although sunflower has increased in importance in recent seasons.

The majority of sample households grow more maize than they require for home consumption so they can sell some. Less than 12% of households reported that in most seasons they exhausted their grain supplies before the next harvest (Stanning, 1986).

ANALYSIS OF FARM HOUSEHOLD GRAIN TRANSACTIONS: CASE STUDY OF HURUNGWE DISTRICT

Setting

Farm-household grain transactions involve both inflows and outflows (Figure 1). Grain sources include own production, purchases, nonmonetary transactions, and carry-over stocks. Purchases may be in the form of grain or mealie meal (milled grain). Nonmonetary transactions include exchange of grain for services (e.g., labour) and commodities (e.g., cooking meat). In the communal subsector, meeting food requirements generally takes priority over other production goals (Stanning, 1986, Table 15). Therefore, own production is generally the dominant source of grain for most rural households; except in a drought season or if the household has limited production resources.

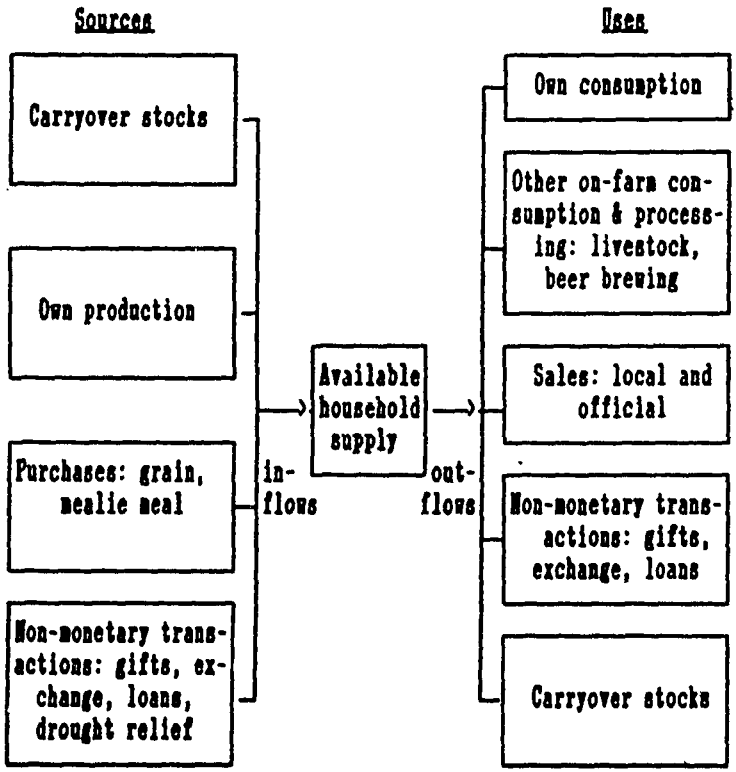
Table 2. Household characteristics in survey locations in Hurungwe District, 1985-87, Zimbabwe.

Household Characteristics (N=83)	Sample Mean	Survey Location Mean				
		Chisape	Mudzimu	Mzilawempi	Fureche	Zvipani
Demographic						
Total size (no.)[a]	7.7	7.2	7.7	5.9	7.7	10.1
Children (%)[b]	55.8	45.1	51.2	51.6	60.0	63.0
Present size (no.)[c]	7.1	6.1	6.6	5.7	7.4	9.7
Adult equivalents (no.)[d]	5.1	4.6	4.7	4.0	5.2	7.0
Livestock						
Cattle owned (no.)[e]	6.8	6.1	4.3	6.7	3.9	12.8
Non-cattle owners (%)[f]	32.0	18.0	36.0	25.0	21.0	0.0
Landcrops						
Field area (ha)[g]	3.9	3.2	4.0	4.6	3.1	4.9
Cropped area (ha)[h]	3.3	2.6	3.0	3.6	2.4	4.6
Maize area (%)[i]	73.0	87.0	81.0	82.0	73.0	56.0
Other grains (%)[i]	3.3	2.5	3.0	5.0	4.0	3.0
Cotton (%)[i]	12.6	4.5	0.0	7.0	17.0	24.0
Other non-grains (%)[i]	11.1	7.0	16.0	0.0	6.0	17.0

[a]Average total household size, unweighted.
[b]Children under 16 years, per total household size.
[c]Average number of members living on the farm, unweighted.
[d]Number of household members living on the farm in adult equivalents.
[e]Average number of cattle.
[f]Percentage of sample households with no cattle.
[g]Average land holding in hectares, excluding garden area.
[h]Average area (ha) under crops per household in 1984-85 season.
[i]Percentage distribution of cropped area, by crop type.

Source: Household survey, Hurungwe District, Zimbabwe.

Figure 1. Model of farm household grain transactions



Households use grain in a variety of forms. There is an on-farm demand for grain for both human consumption and livestock feeding. Households also use grain for nonfood purposes such as labour payment, exchange (particularly for cooking beef), and beer brewing. Surplus grain are sold, either locally or to the parastatal marketing agency, the Grain Marketing Board (GMB).

In Zimbabwe, the relative importance of different forms of grain disposal for any particular grain varies between regions and among households in the same area--depending on both the total and relative availability of different grains, and the particular uses for which certain grains are best suited. For instance, since households give greater priority to home consumption over marketing, the main determinant of market transactions is total production. In regions where maize is the staple food, sorghum and millets are largely used in beer brewing, not for direct consumption. On the other hand, in low-rainfall areas, sorghum and millets are not only used for brewing local beer, but also for home consumption and feeding poultry.

The remainder of this section presents empirical findings from the analysis of grain transactions of sample farmers in Hurungwe District during June 1985 to May 1986. Since maize dominates grain production and exchange in this district (Table 2), the discussion focuses on maize transactions. Purchased mealie meal accounts for a very small proportion of maize utilised. Therefore, it is converted to a maize-grain equivalent and incorporated in the maize transaction data[3].

Producer-maize transactions

The aggregate self-sufficiency of sample households is self-evident (Table 3). Own production accounted for 90% of total maize available to households. Of the remaining balance, only 1% is purchased. The bulk of these purchases (85%) was maize grain, not mealie meal. Nonmonetary transactions were the most important source of maize inflows, other than own productions.

In this category, grain received in repayment for loans of cooking meat--advanced prior to harvest--were predominant. Overall, households in the area are self-sufficient in maize; and deficit households make up their requirements through nonmonetary transactions and local purchases of maize grain.

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[3]The conversion factor used was 1.16, based on estimates of the extraction rate of mealie meal from maize grain.

Data on the disposition of grains clearly show that in aggregate terms, sample households had a large maize surplus. Some 75% of available maize was marketed, over 90% of which was purchased by the GMB. Grain retentions for home consumption accounted for only 13% of available supplies. This represents a per capita consumption of 134 kg of maize per annum, or 184 kg per adult equivalents. This is slightly on the low side, but accessibility to fresh vegetables and income to purchase other foods (e.g., meat, bread, and oil) reduces the quantity of grain needed.

After accounting for home consumption and sales, the remaining maize surplus is utilised for other purposes. A detailed breakdown of these uses is shown in Table 4. Repayments of advances of cooking meat is most important and feeding pigs accounts for the second largest share. It is interesting to note that almost as much maize is used for nonfood farm consumption, processing, and nonmonetary transactions as for home consumption, in terms of its total share of maize disposals (Table 4). This suggests decisions about on-farm retentions are not solely based on family nutritional requirements.

Analysis of the share (%) of maize production and sales by percentile groups, suggests marked inequality in maize market participation (Table 5). Around three-quarters of the sample marketed some maize during the survey period. However, analysis of transactions indicates that 10% of the households accounted for 43% of the marketed surplus. In contrast, one-half of the sample households accounted for no more than 6% of the total maize marketed.

Seasonality of household maize transactions

On the basis of climate and activity patterns, rainfed agriculture in Zimbabwe's communal areas can be divided into three seasons:

- o Post-harvest season (June-September). During this period, farmers have generally completed harvesting maize, and it is being dried and threshed at the homestead for on-farm storage or sale. During the early part of this season, cotton is still being picked, which may delay the threshing of maize. Farmers with access to draft power or hired tractors do winter ploughing; but generally agricultural activity slackens as the season progresses and farmers are free to engage in nonagricultural activities, such as building, thatching, artisanry, postharvest festivals, and visiting relatives.

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Table 4. Farm consumption and nonmonetary transactions of maize, Hurungwe District, June 1985-May 1986, Zimbabwe[a].

Uses	Total Sample	Sample Mean	Sum
Farm consumption and processing	(kg)	(kg)	(%)
Pig feed	10,947	140.3	16.9
Brewed beer for sale	5,688	72.9	8.8
Poultry feed	3,085	39.6	4.8
Brewed beer for ceremony	2,230	28.6	3.4
Cattle feed	337	4.3	0.5
Subtotal	22,287	286.0	34.4
Nonmonetary transactions			
Repaid loans of cooking meat	20,204	261.6	31.5
Loaned to local farmers	6,461	82.8	10.0
Labour payments	5,415	69.4	8.4
Gifts	5,242	62.7	8.1
Exchange	3,658	46.9	5.7
Brewed beer for labour payments	892	11.4	1.4
Repaid other commodity loans	373	4.8	0.5
Subtotal	42,443	544.0	65.6
TOTAL	64,730	830.0	100.0

[a]Excluding direct consumption as human food
Source: Food-grain Study, Hurungwe District, Zimbabwe.

Table 5. Maize production and marketed surplus, by percentile groups, Hurungwe District, June 1985-May 1986, Zimbabwe.

	Lowest 25 percent	Second quartile	Third quartile	Highest 25 percent	Highest 10 percent
Production	5	9	25	61	32
Marketings	0	6	19	75	43

Source: Food-grain Study, Hurungwe District, Zimbabwe.

- o Planting and growing season (October-January). While the initiation of planting activities is determined by the timing of the rains, farmers generally begin to plant towards the end of October. Late plantings of maize are made in early January. The availability of draft power and planting-labour bottlenecks are major production constraints for some households.
- o Cultivation and harvest season (February to May). Farming activities are generally concentrated at the beginning and end of this season with a relatively slack pre-harvest period during March and April. Farm household grain stocks begin to run low and green maize can be an important source of subsistence for deficit households.

To illustrate the seasonal patterns in household maize flows, Tables 6 and 7 present for each month, both the percentage of households participating in each type of transaction and the proportion of total maize transacted from June 1985 to May 1986. As might be expected, activity is greatest during the postharvest period. Both maize sales and maize transfers to repay commodity loans advanced by local farmers are concentrated in July through to September (Table 7). Maize is widely used for other purposes. Use for other purposes also peaks during August and September, but dropped to a fairly consistent level for the remaining months. Except for a slight postharvest peak, the quantity of maize used in home consumption is relatively stable throughout the year, averaging 0.8 bag per household per month.

Since over 80% of the households were self-sufficient in maize during the survey period, little maize came from other inflow sources (Table 6). Overall, maize inflows are concentrated during the postharvest months when households received maize in repayment of loans. Maize purchases are concentrated between December and February when on-farm stocks are falling, but before green maize is available for consumption. Maize from other sources (e.g., gifts and labour payments) are also most important during the postharvest period.

Due to panseasonal pricing and limited local markets, there is little incentive for farmers to store more maize then required for their own use. By the end of October, most households had disposed of surplus maize. The mean stock level was below 10 bags per household, equivalent to 1.4 bags per capita (Table 8). Most households had on-farm maize stocks through to February 1986. Thereafter, the percentage of households with maize in storage declined sharply as households used the current crop for home consumption. The low level of on-farm stocks at the end of April shows that very little maize is carried forward to the next season. Farmers explained this by pointing to both the poor storability of hybrid maize and there did not need to maintain on-farm stocks because they anticipated good harvest in the current season.

Table 6. Sources of maize inflows by month, Hurungwe District, June 1985 - May 1986, Zimbabwe[a].

Month	Purchases		Nonmonetary transactions: Loans Received		Nonmonetary transactions: Loan Repayments received		Nonmonetary transactions: Other	
	Farms	Total[b]	Farms	Total[c]	Farms	Total[d]	Farms	Total[e]
Jun	1	3	5	12	6	6	1	3
Jul	0	0	0	0	15	45	4	3
Aug	0	0	0	9	18	17	3	29
Sep	4	4	4	26	10	9	3	3
Oct	3	4	0	0	4	0	5	15
Nov	8	8	1	1	1	5	5	11
Dec	10	17	4	19	6	0	14	14
Jan	17	11	1	5	0	1	16	14
Feb	16	9	6	29	3	0	14	5
Mar	11	3	1	5	0	0	15	3
Apr	8	2	3	2	0	0	3	0
May	3	1	1	3	0	0	1	0

[a]Data for "farms" indicate percentage of sample households receiving grain from the respective source in that month. Data for "total" indicates the percentage of total inflows for the respective item in that month. [b]Total purchases were 5.70 mt. [c]Total loans received = 1.96 mt. [d]Total loan repayments received = 32.06 mt. [e]Total other inflows = 7.99 mt.
Source: Food-grain Study, Hurungwe, District, Zimbabwe.

Table 7. Uses of maize inflows by month, Hurungwe District, June 1985 - May 1986, Zimbabwe[a].

Month	Home Consumption		Sales		Other farm consumption and nonmonetary transactions: Loans given		Other farm consumption and nonmonetary transactions: Loans repaid		Other farm consumption and nonmonetary transactions: Other	
	Farms	Total[b]	Farms	Total[c]	Farms	Total[d]	Farms	Total[e]	Farms	Total[f]
Jun	100	11	13	5	6	3	13	10	32	3
Jul	100	10	30	34	5	14	44	32	27	3
Aug	100	7	37	56	6	9	60	33	52	20
Sep	100	7	12	3	9	21	33	20	65	17
Oct	100	9	5	0	3	5	5	2	54	9
Nov	100	8	4	0	8	7	1	0	44	6
Dec	100	9	9	1	15	17	1	0	66	7
Jan	100	9	8	0	4	7	0	0	70	7
Feb	100	7	15	0	3	1	3	0	67	5
Mar	100	8	9	0	4	7	3	2	68	8
Apr	100	8	11	0	5	7	1	1	59	8
May	100	8	3	0	2	2	1	1	49	7

[a]Data for "farms" indicate percentage of sample household using maize for the respective use in that month. Data for "total" indicates the percentage of total maize used for the respective purpose in that month. [b]Total home consumption was 73.1 mt. [c]Total sales was 407 mt. [d]Total loans given = 6.5 mt. eTotal loans repaid = 20.7 mt. [f]Total other = 37.5 mt.

Table 8. Household-maize storage by sample household in Hurungwe District, June 1985 - May 1986, Zimbabwe.

Month	Month end maize storage			
	Farms with stocks (%)	Mean	Total (mt)	Per capita (mt)[a](kg)
June	99	6.1	474	66.7
July	100	5.1	406	57.1
August	100	1.5	120	17.0
September	100	1.1	85	13.4
October	99	0.9	65	9.2
November	98	0.8	64	9.0
December	96	0.7	51	7.2
January	99	0.4	33	4.6
February	86	0.3	22	3.1
March	63	0.2	10	1.5
April	43	0.1	6	0.8
May	22	0.1	10	1.4

[a]Data rounded to the nearest mt.
Source: Food-grain Study, Hurungwe District, Zimbabwe.

Maize transaction categories, by farm type

This section examines maize transactions--and their relationship to production and various household characteristics--in order to identify key determinants of household level maize flows. This analysis will be followed up in future empirical work.

Sample households in Hurungwe were classified on the basis of net maize transactions over the period June 1985 - May 1986. Total net transactions are disaggregated into monetary and non monetary transactions, according to the model presented in Figure 1. On-farm consumption (including nonfood consumption) and storage are specifically excluded from the analyses since these are not transactions--although they obviously influence household transaction levels.

Turning first to monetary transactions, sales, and purchases of maize (Table 9). A small, but significant proportion (± 17%) of households were net buyers of maize during the survey period. These households purchased

Table 9. Net monetary transactions and per capita availability of maize, by household type, Hurungwe District, June 1985-May 1986.

Net monetary transactions (91 kg bags)	Farms (%)	Marketed[b] (bags)	Output/ capita[c] (bags)	Maize area[c] (ha)	Farm size[c] (ha)	Residents[d] (no)	Cattle[c] (no)
SOLD							
>301bags	1	530	38	6.9	7.7	15.0	19
201-300 bags	3	250	24	4.5	9.3	11.5	27
151-200 bags	7	175	41	4.0	6.5	7.8	13
101-150 bags	16	121	25	3.6	5.7	8.9	17
51-100 bags	11	78	17	2.2	5.6	8.1	13
26-50 bags	14	33	11	2.7	4.6	6.6	4
5-25 bags	16	19	7	1.9	2.6	5.7	5
< 5 bags	10	2	3	2.4	3.2	8.3	3
NONE[a]	6	0	3	1.2	2.4	7.5	2
PURCHASED							
< 5 bags	16	0	3	1.3	2.3	5.0	1
> 5 bags	1	0	3	1.6	2.4	4.0	2

[a]No transactions. [b]Mean quantity marketed. [c]Mean. [d]Mean no. household members living on the farm.
Source: Data from Food-grain Study, Hurungwe District, Zimbabwe.

relatively small quantities of maize, compared to their production. Net-buyer households produced less maize per capita than net-seller households and grew a smaller area of maize. Net-buyer households also operated smaller farms, had fewer household members, and owned less cattle than net-seller households.

More than three-quarters of the Hurungwe sample were net-seller households in 1985-86, although the amount of maize marketed varied considerably between households. Just under one-third of households marketed either no maize or less than 25 bags. This suggests they would be reasonably vulnerable to a shortfall of maize in a less favourable season. When this group (sales < 25 bags) is added to the number of net-buyer households, together they account for 50% of the sample population.

A strong association exists between the amount of maize marketed, per capita availability of maize, and output related variables such as maize area, farm size, availability of draft power. This supports the common assumption that the main determinant of marketed surplus is total grain harvested. Regression analysis confirms this relationship. Regressing total production on total quantity marketed gave an adjusted R^2 of 0.96. In other words, 96% of the variation in household marketing was explained by [illegible]iations in production. The strong positive relationship between household [illegible], maize production, and maize sales is in line with findings from other [illegible]-household studies in Africa (Low, 1986, Table 4.3).

Almost all sample households engaged in nonmonetary maize transactions. However, a large proportion of households (60%) exchanged or received less than five bags of maize (Table 10).

Most nonmonetary transactions are related to payments or receipts of grain in exchange for cooking meat. As expected, the analysis showed that generally households with more cattle were net receivers of maize and those with fewer cattle were net exchangers of maize. However, it was quite common for individual households to both receive and give maize in exchange for cooking meat, since households slaughter livestock at different times.

Households receiving in excess of five bags of maize grain also tended to market more maize than other households. This suggests that nonmonetary transactions increased their postharvest maize surplus.

There is some evidence that nonmonetary transactions enable deficit households to increase their maize supplies, since the percentage of net-deficit households for all maize transactions (Table 11) is slightly smaller than the percentage of net-buyer households (Table 9). This difference must be due to nonmonetary transactions received by net-buyer households.

When monetary and nonmonetary maize transactions are aggregated, the overall pattern of total net-maize transactions is similar to that for monetary transactions. Households fall into a similar range of net-transaction categories, although the percentage of surplus households in each category increased slightly. The influence of per capita availability on output related variables was as expected; higher output elicited greater surpluses.

Maize transactions and market access

Access to market influences maize transactions through its effects on returns to marketing. Specifically, it it hypothesized that in a situation with constant yields and constant prices; increased distance to market increases transport costs, lowers returns--resulting in a lower marketed surplus.

However, the importance of distance to market may be offset by either inherent land quality and seasonal factors which raise yield, or by better quality marketing services offered at more distant marketing centres. Under these complicating circumstances, the relationship between distance to market and marketed surplus is not clear. This was the case in Hurungwe where there was no significant correlation between the quantity marketed and distance to market, at distances below 40 km. However, at distances over 40 km, the amount of maize marketed declined sharply with distance to market (Table 12).

Only a small proportion of total marketings (± 4.0%) was delivered to the two GMB collection points (Mudzimu and Chidamoyo) that fall within the survey locations. All maize deliveries to collection points were transported less than 10 km, generally using farmers' own transport such as scotch carts. Since the mean level of transactions was quite small (1.5 mt) the households utilising collection points were probably those marketing small quantities of maize. This suggests that collection points provide market access primarily to

Table 12. Maize sales by distance to market and share purchased by different buyers, Hurungwe District, June 1985 - May 1986.

Distance Interval (km)	Marketings[a] (mt)	Mean[a] (mt)	Sum (%)	Buyer (% share) Local Farmer	Store	GMB collection	GMB depot
<10	43.6	1.5	10.8	1	1	38	60
11-20	39.1	3.9	9.7	0	0	0	100
21-30	151.0	7.9	37.5	0	0	0	100
31-40	119.0	8.5	29.5	0	0	0	100
41-50	40.9	3.7	10.2	0	0	0	100
51-60	3.6	3.6	0.9	0	0	0	100
61<	5.0	5.0	1.2	0	0	0	100
Total	402.3	4.7	100.0	na	na	na	na

[a]Total marketings differ slightly from Table 3 due to missing cases. Some households marketed more than once, so mean is less and number of marketings exceeds the number of sample households.
Source: Data from Food-grain Study, Hurungwe District, Zimbabwe.

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smaller producers. However, before supporting collection points as a means of more widely distributing the benefits of government grain policies, it is valuable to understand why some farmers who were near a collection point, still delivered their maize to a more distant GMB depot; because the GMB depot provided better quality service.

- o Maize delivered to GMB depots is graded on an individual-farmer basis. This ensures that farmers with a good grade of maize are paid accordingly. On the other hand, farmers reported that because collection points operating in 1985 did not have facilities to grade maize, the producer received an average price based on all deliveries to the collection point. To my knowledge this procedure is still followed.
- o Maize delivered directly to the depot is assessed immediately, whereas maize delivered to a collection point often waits several weeks, without adequate protection from the elements, before it is bulked and transported to the nearest depot. This results in a deterioration in quality and delays payment to the producer.
- o Apparently many transporters in Hurungwe only deliver maize to deports and do not service local collection points. Since farmers typically use their own transport to deliver maize to a collection point, this is often impractical if a producer has a large surplus to market.

HOUSEHOLD INCOME FLOWS

Setting

A distinct characteristic of rural households is that their income comes from several sources (Stanning, 1986 Table 12). Although crop production is generally the major source of income, households also engage in noncrop, farming activities such as pig and poultry raising; and nonagricultural activities such as construction and handicrafts. These production activities are interrelated, not only in sharing the same services of factors owned by the household, but also through the internal flow of products (e.g., a part of the maize output is used as feed for pig or poultry).

Earnings from production are typically supplemented by both wage income, earned by family members employed off the farm (e.g., wages from casual labour), and by remittances sent by absentee members and relatives working in urban areas.

Full specification of farm-household income includes the value of agricultural products producers consume directly or use for exchange, as well as monetary income flows. This requires that values be imputed for agricultural products that are consumed on the farm. Data have been collected to estimate total income for survey households, but only cash income flows have been analysed to date. Gross cash income is analyzed, excluding production input costs and services purchased by the farmer. Gross cash income is income at the disposal of the farm household. As such, it impacts on the ability of households to purchase consumption requirements and farm inputs, and to meet other family living expenses (e.g., clothing and school fees). Therefore, information about the sources, level, intra seasonal and intra household distribution of disposable cash income is important in understanding and assessing the coping mechanisms of rural families.

Cash income flows

Data on household income received from all sources (including remittances in kind) were collected each month from sample households over a 12 month period (May 1985 - June 1986). Household cash income averaged Z$1,700 over this period (Table 13).

Maize was by far the most important income source, accounting for 29% of total cash income; followed by remittances from absentee family members and relatives working in urban areas (17%). The relative size of remittances was greater than anticipated and warrants further examination. In particular, the question arises whether remittances are of equal importance to all households or whether they are significantly correlated with particular household types. Local businesses emerged as the third most important source of cash income.

But since this income was almost entirely earned by a few farmers with business interests at local growth points, it is not of widespread significance. Cattle, cotton, and local wage employment were secondary sources of cash income of similar importance.

Overall, families attempt to secure their cash needs from several sources. Although agricultural production activities (crop and noncrop) clearly predominate, links with the urban economy and local nonagricultural activities are also relatively important sources of cash (Figure 2).

Analysis of gross cash income and nonfarm cash income, by percentile groups, suggests marked inequality in income distribution (Table 14). Nonfarm cash incomes were distributed slightly more unequally than total cash income, with 25% of the sample households accounting for nearly 60% of total earnings. The income share of the lowest 50% of the households was below 15%. This suggests that many families in the survey area have limited access to income-generating activities and, therefore, depend largely on their own production to meet consumption requirements.

Seasonal patterns of cash income flows

There were distinct seasonal patterns in household income receipts, primarily determined by seasonality in crop production. Table 13 and Figure 2 show

Figure 2: Proportional pie chart showing total and seasonal composition of household cash income, Hurungwe District, June 1985 - May 1986, Zimbabwe.

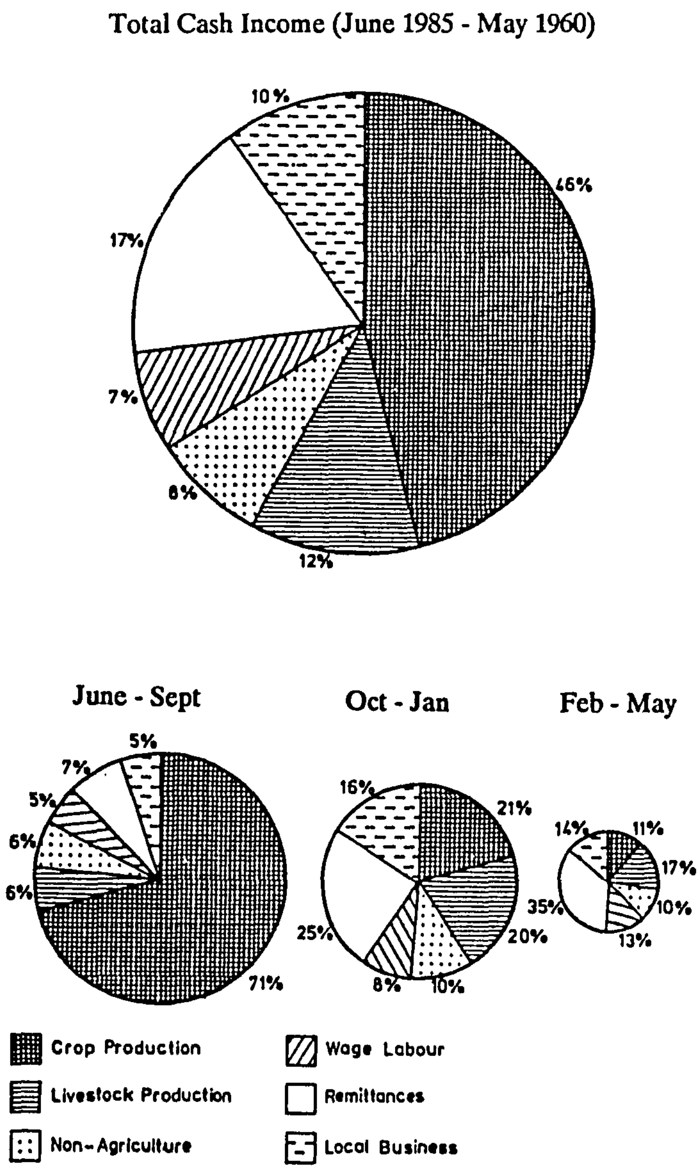

Table 13. Composition of household cash income and distribution by season, Hurungwe District, June 1985-May 1986, Zimbabwe[a].

Source	Total annual income		Seasonal distribution		
	Z$[b] ('000)	Sum %	June to September[c] (row %)	October to January[d] (row %)	February to May[e] (row %)
Maize	38.5	29	82	17	2
Remittances	22.1	17	22	48	31
Local business	12.9	10	27	51	21
Cotton	11.8	9	87	13	0
Cattle	10.5	8	26	51	23
Local wage employ.	9.2	7	38	34	28
Other field crops	6.2	5	76	18	6
Small livestock & livestock prod.	5.5	4	24	54	22
Garden	3.0	2	43	32	25
Home industry	1.6	1	55	29	15
Other grains	1.4	1	72	11	18
Miscellaneous non-agric. activities	8.3	6	36	44	20
Total = $('000)	131.2	na	68.7	42.9	19.6

[a]Mean is calculated on the basis of complete cases. The no. of complete cases varies slightly between seasons. [b]Sample mean equals Z$1,631 (SD = 1883). [c]For June-Sep. the sample mean was Z$838 (SD = 1,228). [d]For Oct.-Jan. the sample mean was Z$543 (SD = 707). [e]For Feb.-May, the sample mean was Z$250 (SD = 265).

Source: Data from the Food-grain Study, Hurungwe District, Zimbabwe.

Table 14. Percentage share of gross cash income and non-farm cash income, by percentile groups, Hurungwe District, June 1985 - May 1986, Zimbabwe.

Income Type	Lowest 25%	Second quartile	Third quartile	Highest 25%	Highest 19%
Gross cash income	6.2	14.0	22.9	56.9	36.0
Nonfarm cash income	4.5	13.1	23.2	59.2	42.5

Source: Data from Food-grain Study, Hurungwe District, Zimbabwe.

that peak income coincided with the months of harvesting and crop sales (June - September), while incomes were lowest during the pre harvest period (February-May). Average monthly income was around Z$140 per household, but varied from an average high of Z$480 in September to an average low of Z$52 in March. Such seasonal patterns in income generate household surpluses (savings) for a few months after harvest and deficits during preharvest period--when households are most likely to purchase consumption goods to supplement dwindling stocks of grain.

The seasonal distribution of income sources differs somewhat from the aggregate pattern. While all sources, with the exception of small grains, provide their lowest contribution to earnings between February and May, certain income sources such as remittances, local businesses, cattle and small livestock, and livestock products were most important during October through January. This corresponds to the planting season and holiday period. In contrast, two income sources--wage employment and sales of garden products--were relatively stable throughout the year.

Income categories by farm type

The dominance of farm production in household income (Table 13) suggests that families with higher income have a better resource endowment. Analysis of the relationship between income categories and farm type supports this hypothesis (Table 15).

Table 15. Income categories by farm type, Hurungwe District, June 1985-May 1986, Zimbabwe.

Gross cash income (Z$)	Farms (%)	Farm size[a] (ha)	Residents[b] (no)	Cattle owned[a] (no)	Absent household head (%)	Employed family member[c] (%)
< 500	14.1	3.9	6.8	1	0	10
501- 750	15.3	2.8	4.9	1	10	20
751-1000	10.3	2.4	6.3	3	38	38
1001-1250	12.8	3.6	6.0	4	13	38
1251-1500	12.8	4.5	5.3	10	11	22
1501-1750	7.7	3.2	6.7	5	50	50
1751-2000	5.1	5.3	8.3	14	25	25
2001-2250	2.5	4.9	9.5	6	0	0
2251-2500	3.8	3.6	10.0	12	0	50
2501-3000	2.5	4.5	10.0	18	0	100
3001-3500	2.5	10.9	9.5	25	0	100
3501-4000	3.8	8.1	12.0	15	0	50
4001-4500	1.2	8.1	11.0	12	100	100
4501-5000	2.5	4.5	15.5	31	0	0
> 5001	2.5	8.1	13.5	23	0	0
Total	100.0	4.2	7.1	6.8	17.0	28

[a]Mean. [b]Household members living on farm. [c]Households with at least one employed family member.
Source: Data from the Food-grain Study, Hurungwe District, Zimbabwe.

Households receiving the lowest cash incomes were labour-poor households, operating below-average-size holdings, and owning very few cattle. Within the cash-income level of Z$1,000 - $3,000 per annum, there was a less obvious association between higher incomes and greater production resources, although the overall trend in household size and cattle ownership follows the trend in cash-income receipts. An interesting relationship exists between the incidence of absentee household heads, proportion of households with at least one family member working away from home, and cash-income categories. Low-income households had a higher incidence of absentee household heads than households with higher cash income. On the other hand, households with incomes in excess of Z$2,000 per annum most frequently had another family member in urban employment.

Household heads from low-income, resource-poor households are more likely to be absent in wage employment due to the comparative advantage of wage employment over farming in Hurungwe District. If these households are also relatively young, the process is reinforced--since younger men tend to have greater wage-employment opportunities than older ones. Households with better resource endowments clearly have a higher potential for generating productive and remunerative on-farm employment for more household members.

Therefore, the need for the head to supplement earnings through off-farm employment is less pressing. On the other hand, if households in this category are older, mature households; they are able to exploit off-farm income opportunities through other household members such as adult sons and unmarried daughters. This is the case among resource-rich, labour-rich sample households in Hurungwe and concurs with findings from previous studies in Southern Africa (e.g., de Vletter, 1981; cited in Low, 1986).

Further analysis of available household remittances and off-farm employment data will provide a clearer picture of the nature and importance of linkages between the rural household economy and the urban wage sector, for different types of farmers.

The positive association between maize transactions and farm resources outlined previously (maize transaction categories, by farm type) and the dominance of farm output in generating cash incomes, suggests that households with a higher net maize surplus will have higher incomes. This is generally confirmed when maize transaction categories are examined alongside income flows (Table 16). Net-deficit households and those with a surplus of less than five bags of maize had below average cash incomes. There was also a tendency for these households to earn a larger share of cash income from non agricultural sources. Consequently, income receipts were less seasonal. In contrast, income was more seasonal among surplus households, since they received a large proportion of their income from crop production.

Table 16. Maize-transaction category and gross cash income flows by source and season, Hurungwe District, June 1985 - May 1986, Zimbabwe[a].

Net household transactions[b] (91 kg bags)	Farms (%)	Gross cash income (Z$)		Source (% share)		Season (% share)		
		Mean	Std. dev.	Farm	Non-farm	Jun-Sept.	Oct-Jan.	Feb-May
BAGS OUT								
> 250	3	6,475	3,675	92	8	88	6	6
201-250	2	12,911	0	33	67	44	41	15
151-200	9	2,838	1,450	75	25	51	42	7
101-150	16	1,830	1,063	67	23	61	21	18
51-100	12	2,437	1,260	59	41	54	33	13
20- 50	18	743	536	59	41	44	35	21
5- 25	19	1,243	475	64	37	26	35	39
NONE[c]	0	na	na	na	na	na	na	na
BAGS IN								
< 5	9	669	447	46	54	49	35	16
> 5	3	621	18	12	88	23	44	34
Total	100	1,631	1,883	59	41	52	33	15

[a]Data rounded to the nearest percentage. [b]Net of all transactions made by all households. [c]No sales.

CONCLUSIONS AND POLICY IMPLICATION

The preceding sections have examined the level and seasonality of household maize transactions and income flows of Hurungwe Communal farmers. The investigation was undertaken in a province where maize sales to the GMB have increased at around 30% per annum over the last six years. Therefore, this situation provides an opportunity to investigate policy issues associated with the emergence of the communal farmer as an important contributor to marketed surplus. The main findings and conclusions are considered in relation to the four key issues identified at the beginning of this paper.

Forecasting communal maize sales to the GMB

Around three-quarters of the sample households marketed maize over the period, June 1985-May 1986. Average sales were just over 5 mt per household, although the level of marketings varied considerably between households; with many farmers marketing small amounts.

The size of harvest was the only consistent explanatory variable associated with marketed surplus. Nonoutput variables such as distance to market were not highly associated with marketed surplus, although little maize was transported more than 50 km.

Almost all maize sales were made to the GMB and participation in local markets was very limited.

Per capita maize consumption was estimated at 134 kg per annum. Maize was widely used for nonfood purposes such as to repay loans of cooking meat advanced prior to harvest (most important); followed by its use as a pig seed. Nonfood uses of maize were almost as significant as home consumption, in terms of its total share of disposals. This suggests that decisions about on-farm retentions are not solely based on family nutritional requirements and that there is a need to better understand factors influencing communal farmer's use of maize for non-food purposes.

These findings suggest that improved forecasts of communal area sales will require better informed forecasts of communal production; and must also take into account the nature, level, and trend in the use of maize for nonfood purposes--in addition to subsistence requirements--to obtain realistic projections of retentions.

Marketing activities and market access

Marketing activities and market access, in terms of linkages to the GMB, are reasonably well developed in the survey area since producers are served by GMB depots at Karoi and Magunje District Growth Point and there are also a number of collection points in the district.

A large proportion of total marketings was delivered to one of the two GMB depots serving the area. Quite a few farmers whose closest delivery point was a GMB collection point, marketed their maize at one of the GMB depots because they believed the depot provided better marketing services. This suggests that the benefits obtained by selling at a GMB depot compensate for the additional cost of transporting maize a greater distance. Future expansion of the GMB infrastructure in rural areas needs to recognize that quality of service, as well as market access, influence market participation.

The small number of producers in the sample who delivered maize to a collection point makes it difficult to draw conclusions about the types of farmers benefitting from this facility. However, since households utilising collection points marketed small quantities of maize, this suggests that collection points are providing market access to the rural poor.

Maize sales are concentrated in the postharvest period. This places considerable pressure on the local transport systems and also means that the GMB carries the full burden of storing the nation's surpluses.

Factors influencing the demand for grain in rural areas

Household grain consumption is influenced by several factors, including household size, income, and the price of maize and other consumer goods. This paper does not investigate these factors, but empirical work to study these relationships is under way. Therefore, the present discussion is limited to policy issues primarily related to household demand for purchased grain.

During the survey period, own production was the dominant source of grain for sample households. Therefore, there was little demand for maize from additional sources. Maize purchases accounted for less than 10% of total maize consumption. These purchases were concentrated during December-February when on-farm stocks were lowest and before maize from the current harvest was ready. Households purchased primarily local maize grain, rather than maize meal, because it both stores better and is generally cheaper. Thus, in a good season there is very little demand for meal in a grain surplus area such as Hurungwe because deficit households can purchase their requirements from local farmers.

However, analysis of the net transactions position of households indicate that the self-sufficiency of households is somewhat precarious. Just under one-third of the households marketed less than 2.25 mt of maize. Thus, in a less favourable season they could move into a deficit position.

When monetary and non monetary transactions are aggregated, the self-sufficiency of households improves since non monetary transactions (e.g., gifts, labour payments, and receipts of grain in exchange for other commodities) enable deficit households to make up their shortfall.

These findings suggest that the demand for purchased grain in rural areas is likely to vary considerably across regions and between seasons. In good years, the demand is minimal--whereas in poor years, demand increases. However, the level of demand in poor years depends on the extent that on-farm production no longer meets subsistence requirements. In the more productive communal areas, which include Hurungwe, lower production would decrease the market surplus; but need not significantly increase the demand for purchased grain if production was sufficient to meet food requirements.

It is often suggested that more maize-processing facilities should be sited in rural areas because it is inefficient to transport maize to urban areas for milling, only to reexport it to rural areas. This argument requires careful consideration since it appears to assume that maize surplus areas have a sufficient and regular demand for purchased maize to justify investment in commercial milling plants. This is unlikely, based on the situation in Hurungwe.

In communal areas with considerable seasonal instability in marketed surplus, rural consumers could be served by establishing district level centres to act as both grain-purchasing and grain-selling depots. Also, the arrangement could benefit existing small-scale grinding mills in rural areas by maintaining the demand for their services in poor seasons. Yet, the financial viability of such centres would have to be studied closely to establish if the potential savings in transport costs would offset the implementation cost.

Increased communal maize production in Zimbabwe has caused a downward trend in rural demand for maize meal. At the same time, the variability about this trend has probably increased because most communal producers farm in medium and low-rainfall areas, subject to periodic drought. Zimbabwe is still adjusting to this phenomena and needs to consider ways of efficiently servicing a rural demand with considerable interseasonal variation.

Distributional consequences of government grain policies

Several findings indicate marked inequality in the distribution of both maize marketings and cash income among sample households. Since Hurungwe is one of the better communal areas, this is particularly significant.

Analysis of maize transactions indicated that 43% of marketed maize surplus was accounted for by 10% of the sample households. In contrast, 50% of the households accounted for no more than 6% of the total maize marketed.

There was strong positive association between the amount of maize marketed, per capita availability of maize, and output related variables such as maize area, farm size, and availability of draft power. Households with better resource endowments and larger labour resources produced the largest maize surplus. Net deficit and marginally surplus households tended to be labour poor households operating below-average-size farms and owning few cattle.

Since maize, the most important income source, accounted for 20% of total cash income; it was not surprising that there was marked inequality in the distribution of cash income, with the top 25% of the households accounting for 57% of earnings. The income share of the lowest 50% of the households was only 20%. Nonfarm cash income, of which remittances were the most significant, was distributed slightly more unequally than total cash income. The nonfarm income share of the lowest 50% households was below 15%, which suggest that half the families in the survey area have limited access to nonfarm income-generating activities; and therefore, depend largely on their own production activities to meet their consumption requirements. The relationship between income categories and farm type was as expected; low incomes were associated with households having the least resources.

Government's post-independence emphasis on the peasant sector has done much to redress the imbalance in access by communal farmers to extension, credit, and marketing services. These efforts have produced visible results. Communal production and marketing of key food crops such as maize, which had been the domain of large-scale farmers, has grown in importance. However, these developments have not affected all segments of the communal farm sector equally, as illustrated by the grain transaction and income data from Hurungwe District. Since Zimbabwe's basic policy objective is growth with equity, there is a pressing need to identify programmes and policies in both agriculture and other sectors which will enable a larger proportion of the communal farm sector to share in the benefits of development.

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WHEAT PRODUCTION AND IMPORTS IN THE SADCC REGION: WHAT ARE THE TRADE OFFS?

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THE POLITICAL ECONOMY OF WHEAT CONSUMPTION AND PRODUCTION WITH SPECIAL REFERENCE TO SUB-SAHARAN AFRICA

D. Byerlee and M. L. Morris[1]

INTRODUCTION

Over the past 25 years, one of the most dramatic changes in dietary patterns in developing countries has been the increasing role of wheat as a staple food. Wheat consumption has risen rapidly both in countries where wheat is a traditional staple (e.g., in the Middle East and North Africa) and in countries where wheat is an "introduced" food, especially in the tropical countries lying between 23°S and 23°N latitude (Table 1). In most cases, increased wheat consumption has been made possible by rapid increases in imports; over 80% of increased wheat consumption over the past two decades in these two groups of countries has been supplied from wheat imports (Table 1). Only in the large mixed-cereal economies of India, China, and Mexico that experienced the Green Revolution in wheat production has increased wheat consumption been largely supplied from domestic sources.

Wheat imports to developing countries doubled during the 1970s and now account for two-thirds of world wheat trade. Even in the 1980s when wheat imports to most developing countries have levelled off or declined, wheat imports to tropical countries have continued to increase, especially in Sub-Saharan Africa (Figure 1).

While the phenomenon of rising wheat consumption made possible by imports is widespread and has similar underlying causes (Byerlee, 1987), the focus in this paper is on wheat on the tropical countries lying between 23°N and 23°S. To a remarkable extent, these latitudes define the areas of the world where wheat is not grown commercially (except for a few isolated high-altitude regions), including most of Sub-Saharan Africa, Southeast Asia, and Central America, as well as the Andean zone of Latin America. Countries within this tropical belt fall into two groups: the rice-based economies of Southeast Asia; and the tropical countries of Sub-Saharan Africa and Latin America where maize, sorghum, millet, and roots and tubers are the traditional staple foods. Both groups of countries face a fundamen-

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Table 1. Wheat consumption and imports in the developing countries, 1961-65 to 1981-85.

	Consumption per capita (kg/year) 1961-1985	1981-1985	Total wheat imports (mill mt) 1981-1985	% increased consumption imported 1961-1985	% self-sufficient in wheat 1981-1985
Countries where wheat is a traditional staple[a]	114	140	29	85	77
Large mixed-cereal economies[b]	34	77	12	0	92
Tropical nations where wheat is not a traditional staple[c]	16	26	21	83	19

[a]North Africa, Middle East, and Argentina, Chile, and Uruguay. [b]China, India, and Mexico. [c]Countries between 23 S and 23 N latitude.

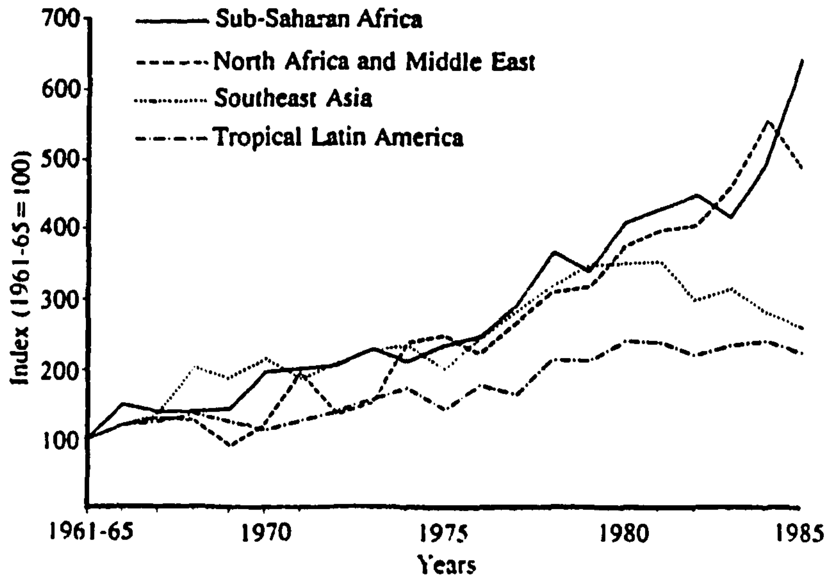

Figure 1. Indices of Wheat Imports in Selected Developing-Country Regions (1961-65 to 1985)

tal conflict between rising wheat consumption, over 80% of which is imported, and the limited potential for domestic production.

These countries have a combined population of about one billion people, consuming an average of 25 kg/capita of wheat annually. However, this aggregate consumption figure conceals considerable regional variability in consumption levels. In tropical Latin America, wheat has already become a staple food for a large proportion of the population, with consumption averaging about 50 kg/capita per year (Table 2). Average consumption in Sub-Saharan Africa is only 15 kg/capita, but with per capita income averaging less than one-third that of tropical Latin America, the potential for continued increases in wheat consumption is obvious.

The rapid growth in wheat imports and consumption raises a set of difficult questions for African policy makers. Will Sub-Saharan Africa follow the example set by tropical Latin America, with wheat over time becoming the main staple substituting for coarse grains, roots, and tubers? What are the political and economic implications of such a change in dietary patterns? What policies and strategies can African countries adopt now to slow these trends? To what extent might domestic wheat production reduce dependency on food imports and at the same time contribute to economic efficiency and food security objectives?

In addressing these questions, we first describe major changes in wheat production and consumption in tropical countries where wheat is not a traditional staple, with particular reference to Sub-Saharan Africa. We then provide a general framework for analyzing changing dietary patterns with respect to wheat. This framework is applied to a cross-sectional analysis of

Table 2. Summary of trends in wheat consumption in the tropics, 1961-1985.

	Per capita wheat consumption	
	Average (kg/year)	Growth (%/year)[a]
Tropical Africa	15	3.3
Tropical Asia	17	3.5
Tropical Latin America	50	1.7
Average - all tropical countries	26	2.4

[a]1961-65 to 1983-85

wheat consumption in tropical countries. This leads to a discussion of the various policy and socioeconomic factors promoting increased wheat consumption in Sub-Saharan Africa. Finally we review economic and policy issues relating to wheat consumption and production in Sub-Saharan Africa that need to be addressed if the region is to reduce its dependency on imported wheat.

OVERVIEW OF TRENDS IN WHEAT IN TROPICAL COUNTRIES WITH PARTICULAR REFERENCE TO SUB-SAHARAN AFRICA

Wheat in the tropical countries

In 1981-85, 45 of the countries lying between 23°N and 23°S (of which 15 are in Africa) each consumed over 100,000 mt of wheat annually. Only 11 of these produced over 100,000 mt of wheat, mostly in highland areas (Table 3). Except for this small group of wheat producers, the rest were highly dependent on imports, which comprised over 80% of all wheat consumed.

Per capita consumption of wheat in the tropical countries varies from less than 5 kg/year in Thailand, Malawi, and Malagasy to over 100 kg/year in Cuba. Consumption is much higher in the Latin American countries (averaging 50 kg/year) than in the Asian and African countries (averaging about 16 kg/year) (Table 2). In the Latin American tropics, wheat now accounts for over one-quarter of staple food calories, compared to less than 10% in Asia and Africa. However, consumption is expanding much faster in the latter

Table 3. Wheat production and imports in tropical countries, 1981-85.

	Population (mill) over	No. of countries consuming over 100,000 mt	No. of countries producing (mill mt) 100,000 mt	Total wheat production (mill mt)	Total wheat imports (%)	Consumption imported
Sub-Saharan Africa	438	16	7	1.6	5.0	76
Tropical Asia	339	14	1	0.2	5.7	96
Tropical L.America	270	15	3	3.2	10.4	76
Total	1,045	45	11	5.0	21.1	81

Source: FAO Tapes.

group; at current growth rates, per capita consumption of wheat in tropical Africa and Asia is doubling every 20 (Table 2).

Wheat in Sub-Saharan Africa

During each of the last two decades, wheat consumption in Sub-Saharan Africa increased at a rate of over 8% annually, or 3.3% per capita (Table 4). The fastest growth occurred in West Africa, where per capita consumption increased by over 6% annually. Nigeria led the way with an extremely high annual growth rate of over 12%. In contrast with West Africa, by the early 1960s wheat consumption was already more established in Eastern and Southern Africa, and significant quantities of wheat were being produced locally. During the last two decades consumption in this region grew more slowly (Table 4). In a number of countries, especially in Southern Africa (Malawi, Zambia, Tanzania, Lesotho, Mozambique) per capita consumption actually fell during the decade 1971-75 to 1981-85 (see Appendix A for country statistics).

Perhaps the most revealing statistic of all is that wheat consumption has been increasing rapidly in Africa, even as per capita food consumption has been falling. While per capita cereal consumption in Africa decreased by about 10% during the last two decades, the share of wheat among all cereals consumed increased from about 5% to over 10%. Hence, increased wheat consumption has come about entirely from substitution for other staple foods. Table 5 shows that food calories supplied by wheat have substituted largely for sorghum, millet, and roots and tubers. Rice in West Africa and maize in East Africa have also increased their share of food calories. However, it is not clear how long this latter trend will continue. The experience of the tropical Latin American countries would suggest that as incomes rise, wheat and rice eventually substitute for maize in the hierarchy of food preferences.

While per capita wheat consumption in Africa has increased rapidly, per capita wheat production has fallen. Wheat is a significant crop (over 25,000 ha) in only five African countries, of which only two, Tanzania and Zimbabwe, increased wheat production faster than consumption from 1960 to 1980--and even Tanzania and Zimbabwe have once again increased their import dependency during the 1980s. In view of this disappointing production performance, over 90% of the increase in African wheat consumption during the last two decades was supplied by imports. Wheat self-sufficiency has dropped sharply, especially in Eastern Africa, and currently nearly 80% of wheat consumed throughout the continent is imported (Table 4).

These broad statistics conceal considerable diversity between individual countries concerning the role of wheat in food consumption. Appendix A provides country statistics on wheat consumption, production, and imports. The most dramatic increases in wheat consumption have occurred in the

Table 4. Wheat consumption and imports by region, Sub-Saharan Africa, 1961-1985.

	Wheat Consumption Per Capita		Growth Rate Consumption Per Capita		Percent Self-Sufficiency in Wheat	
	1961-65	1981-85	1961-65 to 1971-75	1971-75 to 1981-85	1961-65	1981-85
	(kg/year)		(%/year)			
Sahel	3.6	9.3	3.4	6.1	8	2
Coastal West Africa	3.6	13.4	7.0	6.2	7	2
Central Africa	4.8	9.8	4.4	2.7	3	4
Eastern Africa	13.2	19.2	1.2	2.5	76	44
Southern Africa	10.9	17.5	4.7	0.1	30	26
Total	8.0	15.7	3.3	3.3	51	24

Source: FAO Tapes.

Table 5. Changes in daily food calories per capita obtained from different staples in Africa and tropical Latin America, 1961-65 to 1975-77.

Region	Wheat	Rice	Maize	Other cereals	Roots and tubers	All staples
AFRICA						
Eastern and Southern	26	11	48	-58	-21	6
Western	39	30	11	-95	-5	17
TROPICAL LATIN AMERICA						
Mexico and Central America	59	24	-24	-5	-23	54
Andean Countries	23	71	-42	-18	-6	28

Source: FAO Tapes

Ivory Coast, Nigeria, Mauritania, Sudan, and Somalia; where consumption increased by over 10 kg/capita/year in the past two decades. Only Sudan is a significant wheat producer. On the other hand, there are a number of countries, such as Madagascar, Malawi, and Rwanda, where wheat consumption is still very low (< 5 kg/capita) and rising slowly.

A FRAMEWORK FOR ANALYSING THE DYNAMICS OF WHEAT CONSUMPTION AND IMPORTS

Figure 2 is a schematic representation of the complex of factors underlying the dynamics of wheat consumption and imports in the developing world. Both domestic and international actors influence wheat consumption. On the domestic side, the main actors are: (a) producers; (b) consumers; and (c) local grain transport, storage, and processing industries. The main international actors are private and public agencies involved in the world wheat trade. In some cases, such as in grain shipment and processing, international and domestic actors may be closely linked.

"Natural" market forces operating on both the demand and supply sides tend to promote wheat consumption. With increasing incomes, consumer preferences generally favour wheat, especially in countries where wheat is not a traditional staple and consumers are seeking to diversify diets. The world supply of wheat and world market prices also favour consumption of wheat products, because rapid technological change in major wheat-producing countries (e.g., the United States, India, and China) has increased pressure for disposal of surpluses at concessionary prices.

A central thesis of this paper is that governments in both importing and exporting countries are key actors whose interventions in wheat markets consistently reinforce market phenomena and rapidly accelerate the substitution of wheat products for traditional staples. Government interventions on the domestic side are shown toward the right-hand side of Figure 2. These include: (a) interventions in production of wheat and competing food staples; (b) investments, taxes and subsidies, and controls on the marketing and processing of wheat, both domestic and imported; (c) explicit consumer subsidies on wheat products; and (d) influences on consumers' preferences through market promotion and development. Government interventions in international markets are shown toward the left-hand side of Figure 2. Governments of both importing and exporting countries influence the price of imported wheat, for example through: (a) trade and exchange rate policies, (b) subsidies and credit facilities for wheat exports, (c) the provision of food aid (largely wheat), and (d) marketing and promotion policies by private and public agencies of exporting countries.

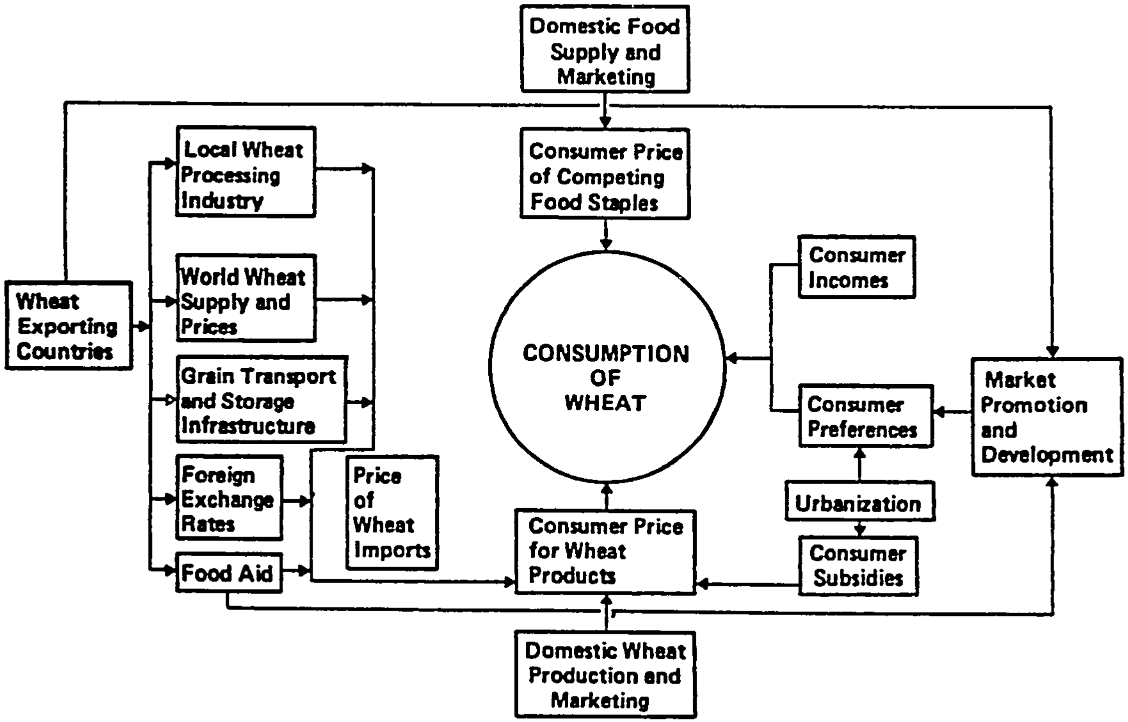

Figure 2. Major influences on wheat consumption and imports in the Third World

Finally, it is hypothesized that a number of influential private sector interest groups are also important in biasing policy interventions toward wheat consumption and imports. These interest groups include middle-income urban consumers (who often are able to influence food policy decisions), the wheat-processing sector (which exercises considerable market power in protecting its vested interests), and exporting interests in developed countries, such as grain exporters or milling and shipping industries (which frequently have strong commercial linkages with processors in importing countries). In addition, interest groups in exporting countries also succeed in distorting the policies of these countries toward wheat exports to the developing world. To a large extent, all of these interest groups reinforce each other in promoting wheat consumption.

CROSS-COUNTRY ANALYSIS OF WHEAT CONSUMPTION IN THE TROPICS

The main hypotheses of the above framework are supported by regression analysis of factors explaining cross-sectional variation in per capita wheat consumption in 40 tropical countries (20 of them in Sub-Saharan Africa) that import at least two-thirds of their wheat. Two equations were estimated to explain: 1) total wheat consumption (including food aid), and 2) wheat consumption based on commercial imports alone (excluding food aid). The regression results are shown in Table 6. The relatively high R^2s (0.81 and 0.78, respectively) indicate that the model explains a high proportion of the variation in per capita wheat consumption among this group of countries.

The strongest determinants of total per capita wheat consumption in the sample are per capita income and urbanization. (Unfortunately, the high correlation ($r = 0.83$) between these 2 variables does not allow their separate inclusion in the regression analysis.) Increasing income and/or urbanization has a strong effect on wheat consumption, with the income elasticity of demand estimated at 0.7. However, the negative coefficient on the quadratic term for per capita income indicates that consumption stabilizes at about 50 kg per capita at an income of about US$3,000 per capita (roughly the income level of Singapore and Venezuela). Wheat consumption is also negatively and significantly related to the consumer price of bread (Table 6). The estimated price elasticity of demand of -0.6 suggests that consumer price policy is an important factor explaining variation in wheat consumption in the sample.

Two variables represent the effects of food aid. Current food aid (which is significantly and negatively correlated with GNP) increases total wheat consumption by the amount of food aid, as indicated by a coefficient of close to unity for food aid in equation 1. Suprisingly, there appears to be no substitution effect of food aid for commercial wheat imports (equation 2).

Equally interesting is the positive effect of wheat imported in the past as food aid ("cumulative food aid" in Table 6) on current commercial imports of wheat. A major objective of food aid donors has been to establish markets for wheat products in countries where wheat is not a traditional food by changing consumer preferences; this strategy has apparently been successful. Other influences may also explain the positive relationship between past food aid and current imports. Food aid seems to have been a forerunner of bread subsidies in a number of countries. A significant negative correlation between cumulative food aid and current bread prices (r = -.46) supports this hypothesis. Overall, the coefficient estimated for cumulative food aid indicates that for every 10 mt of food aid received from 1955-75, approximately 1 ton of additional wheat was added to commercial imports annually in 1979-81.

Wheat imports are negatively related to domestic cereal production, which in this group of countries does not include wheat. However, the elasticity of wheat imports with respect to domestic cereal production is relatively low at 0.3, indicating that domestic staples such as maize and sorghum are not strong substitutes for wheat.

Finally, there is little difference between the factors influencing commercial wheat imports and total wheat imports. As expected, commercial imports are slightly more elastic with respect to prices and incomes (Table 7).

POLITICAL ECONOMY OF WHEAT CONSUMPTION

The cross-sectional analysis highlights the importance of urbanization and incomes, consumer prices, and food aid in influencing wheat consumption in tropical countries. We now examine each of these in more detail, with particular reference to Sub-Saharan Africa.

Incomes, urbanization and food preferences

The income elasticity of demand for wheat across Africa generally ranges from 0.5 to 1.0, which is higher than for any other cereal staple. Wheat consumption in Sub-Saharan Africa was initially an urban phenomenon (Kilby, 1964; Young, 1972; Mwangi, 1982; Franklin *et al.*, 1982). Today, in most countries the consumption of wheat in urban areas is still at least double that of rural areas. Figure 3 demonstrates that this differential between rural and urban areas declines as national per capita wheat consumption increases. In general, wheat is initially consumed by middle to high income groups, usually as bread; typically, the richest 25% of households have a per capita consumption of wheat twice that of the poorest 25% of households.

Table 6. Estimated coefficiants from regression analysis of wheat consumption in tropical countries (based on cross-sectional data).

	Per Capita Total Wheat Consumption (1979-81) (kg/year)	Per Capita Commercial Wheat Consumption (1979-81) (kg/year)
INDEPENDENT VARIABLES	EQUATION 1	EQUATION 2
GNP/capita ($US 1980)	.027	.027
	(.0053)**	(.0052)**
GNP/capita) ($US 1980)	-.462x10^{5}	-.463x10^{5}
	(.118x10^{-5})**	(.117x10^{-5})**
Cereal production/capita	-.058	-.058
(kg/year) (1979-81)	(.020)**	(.020)**
Current wheat food aid/capita	.861	.001
(kg/year) (1979-81)	(.414)*	(.003)
Cumulative wheat food aid/capita	.091	.090
(kg/year) (1955-75)	(.036)**	(.036)**
Price of bread	-.178	-.178
(US cents/kg) (1979-81)	(.052)**	(.051)**
Constant	25.22	25.19
n	39	39
R^2	.81	.78

t-values given in brackets: ** significant at 5% level.
* significant at 1% level.

Table 7. Cross-country income and price elasticities of demand for wheat products[a].

	Income elasticity of demand	Price elasticity of demand
Total wheat consumption including food aid	.67	-.55
Total wheat consumption based on commercial imports	.75	-.63

[a]Computed from equations presented in Table 6. Elasticities estimated at the mean level of each variable.

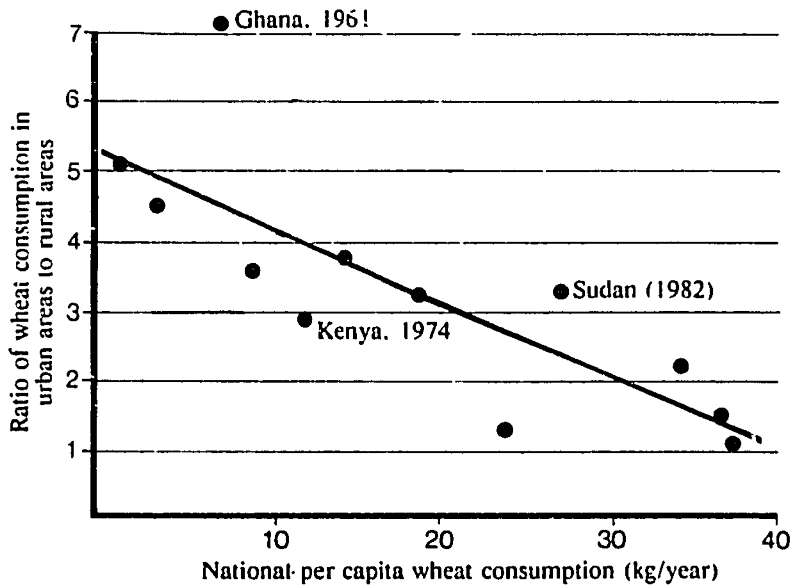

Figure 3. Relationship between the ratio of urban to rural per capita wheat consumption and national per capita wheat consumption in tropical countries

These figures highlight the tendency for wheat to substitute for other food staples as incomes increase and as urbanization proceeds. There is considerable evidence that wheat is preferred as a convenience food. In urban areas, consumers switch to processed foods which require less preparation and help reduce the cost of cooking fuel (Mwangi, 1982; Reardon, 1987). There is also some evidence that women's participation in the urban labour force increases bread consumption (Franklin *et al.*, 1982; Alderman, 1986; Reardon, 1987).

Urban food supplies and wheat imports

A number of factors operating on the supply side also encourage wheat consumption in urban areas. In view of strong consumer preferences for wheat products, lagging domestic production of staple foods, and poor infrastructure for transporting and marketing domestically produced food in urban areas, there has been a natural tendency to import wheat to feed urban consumers, especially in countries where large cities are located on the coast (e.g., Nigeria, Senegal, Ivory Coast). This is evident in the relatively low year-to-year variability in wheat imports by most countries; wheat imports have increased steadily, with little relationship to domestic cereal production (Byerlee, 1987).

Although the use of wheat imports to feed urban consumers is often initiated as a "temporary" measure, the practice can easily become entrenched, especially once wheat marketing, storage, and processing infrastructure has been developed. Because these investments are usually oriented toward port facilities and located in large coastal cities, they cannot readily be utilized to market domestically produced food. In addition, the wheat-processing industry is highly wheat specific and cannot easily be converted to processing local cereals, either because processing facilities are located at a substantial distance from the domestic wheat-growing region or, more commonly, because wheat is not produced locally. Indeed, the wheat-processing industry is often a powerful interest group able to influence grain procurement strategies. The processing sector in developing countries has grown very rapidly in Africa in the last 10-20 years as the proportion of wheat flour in international wheat trade has declined.

While grain is cheaper than flour to transport, there is little evidence that it is an efficient use of resources to establish a capital and foreign exchange intensive local milling industry in countries where wheat is not produced. The milling industry usually receives high tariff protection from imported flour and, in many cases, operates at a high margin relative to mills in developed countries (Byerlee, 1987). More importantly, once established, the industry has a vested interest in continuing wheat imports, even if local production of cereals other than wheat offers the opportunity for import substitution.

Bread prices

A major factor in increasing wheat consumption in Africa has been widespread government intervention in food marketing. A number of countries directly intervene to subsidize bread to urban consumers. At least eight Sub-Saharan African countries for which data were available subsidized bread in 1980, with the largest subsidies occurring in Mauritania and Sudan (Byerlee, 1983).

Trade and exchange rate policies also often favour low wheat prices to consumers, relative to the prices of competing staples. Because imported wheat is often regarded as an industrial input to the milling industry, explicit or implicit tariffs for wheat are typically kept low. Meanwhile, other staple foods are protected, either by tariffs (in the case of cereals) or by high international transport costs (for roots and tubers). At the same time, many countries in Sub-Saharan Africa maintain overvalued exchange rates, which reduce the cost of wheat imports, relative to domestically- produced staples.

The effect of these policy interventions on prices of wheat products have been threefold. First, the absolute price of wheat products to consumers is often low. Figure 4 shows the distribution of bread prices in Sub-Saharan countries in relation to a "world" price based on imported wheat. Second, and more importantly, the price of wheat products is often low in relation to competing food staples. Based on world market prices, the ratio of the consumer prices of wheat flour to maize should be close to 2.0. In many countries of Sub-Saharan Africa and Latin America where coarse grains are an important staple (e.g., Cote D'Ivoire, Ghana, Nigeria, Egypt, Sudan, Ecuador, and Brazil), wheat flour based on imported wheat was cheaper than the locally produced coarse grain staple in 1980-81 (Table 8). No country for which data were available was found to have high wheat-flour prices, relative to coarse grains prices (a ratio of 2:1 or above). Third, real consumer prices of wheat products have fallen. Policy interventions in favour of wheat have resulted in a significant decline in the real consumer prices for wheat products, both absolutely and relatively, in one-third of African countries (Figure 5). Declining real prices of wheat products may explain half or more of the rapid increase in per capita wheat consumption in many countries during the 1970s. Although there is strong evidence of bias in consumer pricing policy toward wheat, the consequences of this bias and the reasons for its existence have not been sufficiently analyzed. Several factors appear to converge in favour of low bread prices. The fact that wheat is readily available in world markets and usually passes through a small number of mills makes it relatively easy for governments in importing countries to control prices. Perhaps more importantly, urban populations, particularly middle and upper-income groups who consume much of the imported wheat, are an important political power base capable of influencing retail price policy. In almost all African countries, wheat subsidies have been captured largely by urban populations, generally the middle and upper-income urban groups.

Food aid

Food aid has exerted a major influence on wheat consumption patterns in Africa, which is hardly surprising given that over 60% of cereal food aid is provided in the form of wheat or wheat flour. Food aid to Sub-Saharan Africa has grown rapidly. In the early 1960s, only 1% of all cereal food aid was destined to Africa. This percentage rose to 11% in 1970 and currently stands around 20%. Food aid accounts for one-third of all wheat imports to Sub-Saharan Africa, nearly one-half if Nigeria (the largest commercial importer) is excluded. Currently 13 African countries receive more than one-half of their wheat as food aid, the bulk of them located in the Sahel and East Africa (Table 9). Several of these countries have a long history of

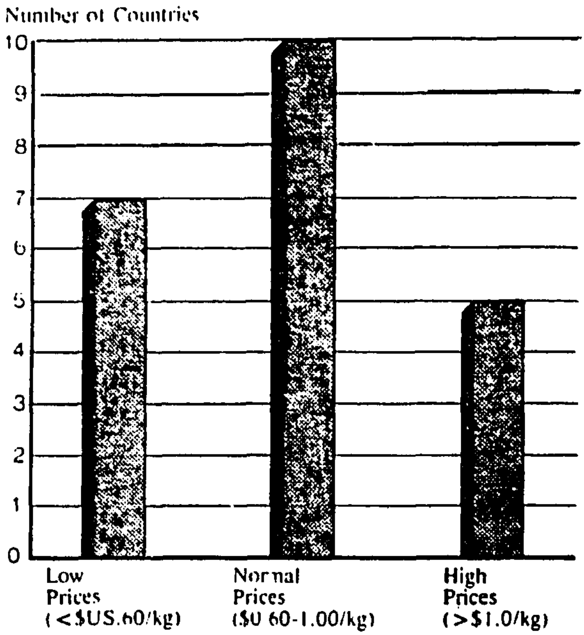

Figure 4. Distribution of Bread Price-Sub Saharan Africa, 1980

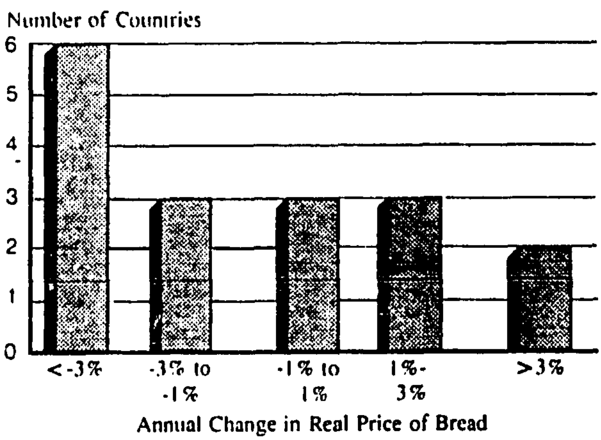

Figure 5. Annual Change - Real Price of Bread, 1971-81

Table 8. Retail wheat flour and maize grain prices for selected countries in Africa and Tropical Latin America.

	Wheat flour[a] (US cents /kg)	Maize grain[a] (US cents /kg)	Wheat: maize price ratio	Comments
AFRICA				
Ghana	131	255	0.5	Overvalued exchange rate
Cote D'Ivoire	31	36	0.9	Subsidy on flour
Kenya	33	24	1.4	
Lesotho	43	26	1.7	
Nigeria	53	52	1.1	Overvalued exchange rate
Zimbabwe	[illegible]	22	1.4	Subsidy on wheat, maize
LATIN AMERICA				
Bolivia	18	28	0.6	Subsidy on flour
Costa Rica	36	23	1.6	
Dom. Republic	40	40	1.0	
Guatemala	45	21	2.1	Subsidy on maize
Ecuador	26	62	0.4	Subsidy on flour
Haiti	59	26	2.3	
Honduras	48	23	2.1	

[a]Converted at the official exchange rate.
Source: CIMMYT Economics Programme Survey.

Table 9. Wheat food aid trends, Sub-Saharan Africa.

	Wheat food aid (1981-83) (mill mt)	Wheat food aid as % of total wheat imports 1971-75 (%)	Wheat food aid as % of total wheat imports 1981-83 (%)	Countries receiving half or more wheat imports as food aid
Sahel	0.17	41	43	Cape Verde, Chad, Mauritania
Coastal West Africa	0.05	11	3	
Central Africa	0.09	66	32	
Eastern Africa	0.85	65	74	Sudan, Ethiopia, Kenya, Rwanda, Somalia, Uganda, Tanzania
Southern Africa	0.20	5	36	Mozambique, Malagasy, Zambia
Total Africa	1.37	17	33	

Source: FAO, Food Aid Statistics (various issues).

receiving wheat as food aid and are among the countries with the highest per capita wheat consumption. The effects of food aid are complex. For short-run food emergencies, food aid is, of course, necessary. However, reliance on food aid, especially wheat, as a regular source of imports has a number of implications:

- o Depending on government pricing strategy in food aid disposal, food aid may lower the consumer price of wheat products, encouraging wheat consumption and discouraging the production of local staples.
- o Food aid exposes consumers to wheat products and is often associated with overt market promotion activities by interest groups in exporting countries.
- o Food aid helps establish a local wheat-processing industry.

The experience of the Andean region during the period 1950-75 should be studied by African policy makers. In the Andean region, these factors combined to bring about a decline in wheat production, rapid increases in wheat consumption, and a heavy reliance on imports (currently over 90% of wheat is imported, most of it commercially) (Valdarama, 1978; Dudley and Sandilands, 1975).

One way for Sub-Saharan Africa to avoid these undesirable side effects of food aid is to accept a greater proportion of food aid in the form of local cereals, especially maize. If food aid is received as wheat, it should be sold at consumer prices that reflect world prices, except in emergency situations. The proceeds of these sales can then be used to support the development of domestic agricultural production, as has been done in Brazil (Hall, 1980).

IMPLICATIONS FOR WHEAT POLICY

Many African policymakers view with alarm the continuing rapid increases in wheat consumption and imports. Responses have varied from country-to-country, and from one time period to another within countries. For example Nigeria, the largest wheat importer in Sub-Saharan Africa, sanctioned wheat consumption in the 1970s by embarking on an ambitious scheme to produce wheat domestically. In 1986 it reversed its policy and became the first African country to ban wheat imports.

Wheat consumption is bound to increase in most countries, since there is a natural tendency to diversify diets as consumer incomes grow. However, in many cases the policies of governments, food aid donors, and exporting countries have reinforced and greatly accelerated the trend. These policies have encouraged a marketing, storage, and investment infrastructure geared to imported wheat that makes it very difficult to reverse the trend toward wheat imports to supply urban consumers. With African urban areas growing at a rate of about 5% annually, the likelihood that wheat imports will continue to increase rapidly is very real. However, a number of policy options should be considered to reduce dependency on wheat imports. We divide these between those that discourage wheat consumption and those that promote wheat production.

Consumption policies

Food pricing policy.

Undoubtedly, the most effective way to reduce wheat consumption and imports in countries that maintain low consumer prices is to raise bread prices. There is ample evidence that wheat consumption is quite sensitive to prices. Removal of consumer subsidies and, in some cases, imposition of a tariff on wheat imports to compensate for overvalued exchange rates are the obvious policy instruments for adjusting bread prices. The objective should be to restore incentives to consume domestically-produced food staples. As a general guideline, the ratio of the price of bread-to-rice and coarse grains (maize, sorghum, and millet) should be about 1.5 and 3.0, respectively.

Senegal is an example of a country where bread subsidies were sharply reduced in the 1970s. As a result, the ratio of the price of bread-to-millet increased from about 1.5 in 1969-71 to 3.0 in 1979-81. The consequences of this policy adjustment were clear: Senegal is one of only three countries in West Africa where per capita wheat consumption fell during the 1970s.

While bread prices clearly are politically sensitive, policy makers and politicians must recognize that the longer a decision to raise prices is delayed, the more difficult it becomes to correct the imbalance. Thailand has maintained high bread prices through import tariffs, depressing per capita wheat consumption to under 5 kg/year and making it still relatively easy to regulate bread prices. In comparison, Sudan has maintained low bread prices through subsidies, raising per capita bread consumption to over 80 kg/year in Khartoum. The Sudanese government is is now finding it very difficult to manipulate bread prices, since bread has become the major food staple for a politically powerful section of the population.

Finally, it should be pointed out that in many tropical countries, low bread prices have produced few benefits to the poor. Rather, the middle and upper-income groups which are the main bread consumers have captured the benefit of these policies; while the farmer, especially the small farmer who produces local staples such as maize, has been the main loser.

Policies affecting the wheat-processing sector

An integrated wheat strategy should carefully rationalize investments in wheat processing, especially large-scale capital and foreign exchange intensive milling and baking plants. Typically, little justification exists for establishing a domestic wheat-milling industry, given the need to use scarce capital efficiently and to promote employment. Removal of tariff barriers to flour imports can effectively arrest the growth of a domestic-milling industry until local wheat production can be established. Importing wheat as flour maintains much greater flexibility in future food policy decisions and also reduces the power of one of the strongest voices in the food policy debate, that of the millers. In addition, tariff protection and tax incentives have been shown to promote the establishment in urban areas of capital intensive modern bakeries which are less efficient than small-scale, labour intensive bakeries, once adjustments are made for overvalued exchange rates, tariffs, and credit policy (Chuta, 1981). Most countries today produce white flour, milled at an extraction rate of 70-75%. Legally mandated higher extraction rates, which produce off-white flour, would allow savings in wheat imports.

Import policy and food aid

Cereal imports to Africa have consisted mostly of wheat and, to a lesser extent, rice. Maize imports, especially to West Africa, have been largely destined for feeding livestock. Yet maize is usually the cheapest cereal in world markets and is a staple food in most tropical countries, especially for the poor. If consumer prices were set to reflect import prices, maize would have considerable potential as a food import[2]. Likewise, more food aid can be provided in the form of local staples. Donors are already moving in this direction. A good example is provided by the barter trade conducted by some SADCC countries. For example, Zimbabwe has provided surplus maize to Mozambique to meet a donor's food aid commitment, and in return receiving wheat from the donor. Despite the large amount of wheat received as food aid, Africa has actually received less than some other regions of the world. Only a little over one-half of cereal food aid destined to Sub-Saharan Africa is wheat, compared to about 75% for all developing regions.

Convenience foods based on local food staples

Bread-making technology in the developing world has been largely imported from the industrialized countries. While relatively little research has been conducted on preparing local foods to meet the taste preferences and convenience needs of urban consumers. Recently, food technologists have initiated considerable research on composite flours, which mix wheat flour with maize, millet, sorghum, or cassava flour for bread making (Mwangi, 1982;

[2]Some difficulties arise because most African countries consume white maize, while yellow maize dominates world markets.

Gomez, Mutambenengwe, and Moyo, 1987). While composite flours appears to be technically feasible, in most countries the greatest obstacle to widespread use, is that pricing policy favours wheat flour over local flours and provides no incentives to use mixtures.

Meanwhile, private and public agencies in wheat-exporting countries have conducted vigorous market promotion programs for wheat products. Governments in importing countries should channel these efforts toward the national interest, perhaps by requiring that exporters undertake research and promotion activities that balance wheat with local food staples. Recently, several countries--including Nigeria, Burkina Fasso, and Sudan--have shown serious interest in composite flour programs, bringing composite flours closer to commercial reality.

Wheat production policies

Only a small proportion of Sub-Saharan Africa is classified as suitable for wheat production. Most of the area that is suitable lies in Ethiopia, Kenya, and Tanzania where wheat production is well established. Zimbabwe and Sudan are also significant wheat producers. In all of these countries except Ethiopia, wheat is a nontraditional crop, and the area planted to wheat is relatively small. In addition to these established producers, a number of countries are attempting to establish a domestic wheat industry (e.g. Zambia, Mali, Nigeria, Madagascar, Cameroon), sometimes with very large investment costs. Many other countries have wheat research programs to evaluate the potential for domestic production.

The environments in which these wheat schemes are being established vary widely throughout Africa, with distinct problems as summarized in Table 10. Hence, it is very difficult to generalize about the potential for wheat production in Africa. In some cases biological factors (e.g., the lack of disease resistant or heat tolerant varieties) constitute the major constraint to local production, while in others economic factors are more important. Here we highlight some economic issues related to domestic wheat production with implications for efficiency, food security, and equity.

Efficiency of domestic wheat production

The comparative advantage framework is useful for assessing the efficiency of domestic wheat production. Parameters such as the domestic resource cost ratio measure the domestic cost of saving foreign exchange through substituting for wheat imports against alternative investments. Experience from several recent studies (Byerlee and Longmire, 1986; Morris, 1987; Longmire, 1987) suggests that a number of factors will be important in influencing the comparative advantage of domestic wheat production.

Table 10. Major wheat production environments and production issues in Sub-Saharan Africa.

Climatic Environment	Example	Major Wheat Production Issues: Biological	Major Wheat Production Issues: Economic
High elevation rainfed (over 1,500 m altitude)	Kenya Tanzania Malawi Rwanda	Appropriate genotypes available, but stripe rust a major problem.	Competing use of land for other temperate crop and/or livestock enterprises.
Mid-to low-elevation rainfed (using stored moisture or growing season rainfall)	Madagascar Zambia	Serious disease problems (e.g., Helinthosporium).	Some competition from staple crops such as maize and sorghum.
Mid-to high-elevation irrigated	Zimbabwe	None	High cost of irrigation and competing use of scarce water.
Low-elevation irrigated	Sudan Nigeria	Heat tolerance and earliness.	High cost of irrigation and competing use of scarce water.

- *Cost of irrigation infrastructure.* In many parts of Africa, investment in irrigation schemes is both costly and foreign exchange intensive. Although reasonably high yields can be obtained for irrigated wheat in the cool-dry season, it is unlikely to be efficient to build large-scale irrigation schemes specifically to produce wheat, as was attempted in Nigeria (Andrae and Beckman, 1985). Even small-scale irrigation schemes have failed to generate satisfactory returns (De Rafols, 1982), unless wheat can be grown as a second crop.
- *The presence of competing enterprises.* If wheat is grown on fallow land as a second crop in a multiple-cropping pattern (e.g., in Madagascar), it may be profitable at quite low-yield levels. However, if wheat competes with export crops (e.g., cotton in Sudan) or other enterprises requiring temperate conditions (e.g., dairying in Kenya), much higher yields are required to make it profitable.
- *The technology used in wheat production.* Use of capital intensive technologies such as tractors and combines reduces the foreign-

exchange savings of domestic-wheat production (and also its comparative advantage if less capital-intensive alternatives exist). Many of the wheat production schemes in Africa (Tanzania, Sudan, Nigeria, Kenya, Zimbabwe) are capital intensive.

- *The location of wheat consumption and production in relation to the port.* The economic profitability of wheat in many countries is critically dependent on transportation costs from the producing region to the consumption center. For example, in 1979 it was estimated that transport costs for wheat from the north of Nigeria to Lagos were about US$65/mt at the real exchange rate. Assuming a CIF price of wheat of about US$200/mt, the cost of imported wheat in the north would have been about US$265/mt (200 + 65), while the value in the north of domestically produced wheat destined for Lagos would have been about US$135/mt (200-65). Given these wide transport margins, it may have been profitable to produce wheat for local consumption in the north, but quite unprofitable to substitute domestic wheat for wheat imports in Lagos. In some countries, this issue is further complicated by the location of processing facilities near the coast. If wheat is to be produced in the interior for local consumption, there is a need to establish small-scale wheat mills in the producing zone.

Food security

It is sometimes argued that even if wheat is not an efficient crop, it should be grown anyway to reduce dependence on imports and to insulate the domestic food supply from world price fluctuations. We think that the food security argument is not very convincing, except in some of the land-locked countries of Southern Africa where political factors potentially influence the ability to import wheat. Wheat in much of Africa is a marginal crop; as such, wheat production is subject to substantial year-to-year fluctuations due to high temperatures, scarcity of irrigation water, or disease. Moreover, yields are often highly sensitive to farmers' management, especially with regard to date of planting in areas with a very short cool season (e.g., northern Nigeria). Hence, wheat production in Africa tends to be quite variable, as evidenced by coefficients of variation (CV) around trend of 45% for Sudan, 30% for Tanzania, 30% for Zimbabwe, and 21% in Kenya during the period 1961-85[3]. These figures compare with a CV around trend of 10% for production in major wheat-producing countries such as India and Turkey, and with a CV around trend of 20% for the import price of wheat over the

[3]Simlarly, in Brazil the CV of wheat production around trend is 34%.

same period. Thus, the world wheat market is relatively stable in comparison with domestic wheat supply in Africa, and insulation of domestic markets is likely to increase, rather than decrease supply variability.

Equity

In certain areas, it may be possible to justify domestic wheat production on the basis of equity considerations. However, since wheat consumption tends to be concentrated in middle to upper-income households, this argument holds only if wheat is produced by small, relatively poor farmers. In the largest wheat producing countries in Africa (e.g., Kenya, Tanzania, Sudan and Zimbabwe), wheat is produced mostly on large-scale commercial farms, both private and public. That wheat is usually not a crop for peasant farmers has become evident when land reform programs have been implemented (for example in Kenya); the small farmers who have benefited from land reform have tended to shift to producing of the local subsistence crop--usually maize--and wheat production has generally declined. Efforts are currently underway in several African countries to develop small-scale wheat production technology (see Longmire and Lugogo, 1987). Yet, it is difficult to be optimistic about the scope for small-scale wheat production, except perhaps in Ethiopia. One of the few tropical countries in Latin America that has established a successful small-scale wheat production program is Guatemala, whose experience should be analyzed further.

CONCLUSIONS

The fact that wheat consumption has increased in Africa over the past two decades from a very small base is not particularly surprising. Several elements of this change do cause concern: 1) the very rapid rate of increase in wheat consumption in many countries, and 2) the rapid rate of increase in wheat consumption at a time when per capita consumption of food has been falling. The ongoing substitution of wheat products for traditional food staples has a close parallel in the tropical countries of Latin America with similar traditional staples (maize, roots, and tubers). In addition, many of the same policy influences that were present in tropical Latin American in an earlier era are now apparent in many African countries--bread subsidies, food aid, export promotion programs, and protection of a local wheat-processing industry (Carbonell and Rothmann, 1977). Unless these phenomena are dealt with, wheat is likely to become a staple food for urban populations in many African countries, as has occurred throughout tropical Latin America (Gray, 1982).

In recent years, the very serious economic and foreign exchange crisis has focused considerable attention on the question of wheat imports to

Africa. Despite widespread recognition that increasing reliance on imported wheat to meet short-run consumption needs is likely to lead to problems in the long-run, wheat imports to Africa have increased more rapidly than to any other region. Sub-Saharan Africa is the only region in the world that has experienced a continuous increase in wheat imports during the 1980s. On the other hand, the recent decision by Nigeria to ban imports will lead to a sharp decline in overall imports to Africa in 1987, even if Nigeria's policy is only partially implemented.

Increased wheat consumption in Africa has been largely based on imported wheat, a phenomenon which is likely to continue into the future. Even in countries with relatively high levels of domestic wheat production, such as Kenya and Zimbabwe, the gap between production and consumption is widening, and self-sufficiency has declined in recent years. In many other countries, most notably Nigeria, heavy investments have been made in production schemes, with few tangible results. Economic factors suggest that wheat in Africa is most viable in areas where it can be grown as a second or third crop, using small-scale technology. Production schemes should be oriented toward local consumption, rather than toward import substitution in coastal cities. Agricultural research to produce varieties with better heat tolerance and disease resistance will slowly expand the frontiers for efficient wheat production in Africa, but technological changes alone are unlikely to enable production to keep pace with present rate of growth in consumption.

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Appendix A.1. Wheat consumption, self-sufficiency and aid for selected countries* in Sub-Saharan Africa.

	Wheat Consumption			Growth Rate		Percent Self-Sufficiency		Percent imports received as food aid	
	Total	Per capita		Per capita					
	1981-1985 (000mt)	1961-1965 (kg)	1981-1985 (kg)	1961-65-1971-75 (%)	1971-75-1981-85 (%)	1961-1965 (%)	1981-1985 (%)	1971-1975 (%)	1981-1985 (%)
Burkino Faso	28	1.8	4.2	8.2	0.7	0	0	28	30
Chad	31	1.8	6.4	9.7	3.4	40	15	65	97
Mali	59	2.4	7.8	9.1	3.0	24	3	69	25
Mauritania	138	12.0	77.6	5.6	14.0	1	0	77	66
Niger	45	1.0	7.8	4.5	17.7	25	5	290	16
Senegal	122	12.2	19.9	6.0	-1.0	0	0	8	29
SAHEL	446	4.1	13.2	9.5	7.6	7	2	41	43
Benin	46	2.1	12.0	7.5	10.9	0	0	40	9
Cameroon	95	4.1	10.1	8.6	0.7	0	1	1	0
Ghana	116	8.3	9.1	1.7	-0.7	0	0	52	24
Guinea	55	6.4	9.5	-3.1	7.4	0	0	74	24
Iv. Coast	183	8.5	20.1	4.8	4.0	0	0	3	0
Liberia	17	4.3	8.3	3.3	3.5	0	0	10	5
Nigeria	1,272	1.9	14.3	12.4	8.8	20	3	0	0
S. Leone	29	6.9	8.4	4.5	-2.5	0	0	7	21
Togo	42	3.4	14.9	3.2	12.4	0	0	14	6
WEST COAST	1,860	3.6	13.4	7.3	6.5	7	2	11	3
C.Afr.Rep.	20	3.3	8.1	4.1	5.2	0	0	3	12
Congo	73	15.0	44.1	5.2	5.9	0	0	5	0
Zaire	195	4.3	6.9	3.6	1.3	4	7	7	47
CENTRAL	334	4.8	9.8	4.5	2.8	3	4	6	33
Burundi	26	3.0	5.8	4.3	2.5	73	32	27	36
Ethiopia	1,169	25.0	28.2	-1.8	3.1	96	63	81	86
Kenya	334	8.6	17.6	5.0	2.3	161	67	4	106
Madagascar	43	4.2	4.6	0.1	0.8	0	1	7	54
Mauritius	84	53.3	82.9	4.0	0.5	0	0	28	20
Rwanda	16	0.5	2.7	15.6	3.0	72	16	110	80
Somalia	161	6.6	36.7	7.3	10.7	0	1	63	67
Sudan	699	12.6	34.3	6.3	4.1	24	22	24	83
Tanzania	144	5.6	6.9	5.8	-3.6	35	53	35	65
Uganda	22	3.4	1.5	-0.9	-6.9	0	42	0	56
EASTERN	2,743	13.2	19.2	1.2	2.6	78	44	29.7	74
Angola	183	11.5	22.0	5.0	1.6	32	5	1	18
Botswana	31	13.3	29.6	4.2	4.0	6	3	0	5
Lesotho	73	63.3	50.3	1.9	-4.1	93	23	8	22
Malawi	28	2.4	4.3	6.9	-0.7	3	3	1	6
Mozambique	142	7.2	10.8	4.6	-0.6	19	5	16	67
Zambia	117	6.7	18.8	13.1	-2.1	2	13	2	47
Zimbabwe	218	18.5	26.6	2.5	1.1	3	78	0	42
SOUTHERN	822	10.9	17.5	4.8	0.1	31	27	5	36
ALL SUB-SAHARAN AFRICA	6,206	8.0	15.7	3.4	3.3	52	24	17	33

*Includes all countries with population > 1 million.

Appendix A.2. Wheat production, data and growth rates for selected countries* in Sub-Saharan Africa

	Production Data (Average 1981-85)			Annual Growth Rates (1961-65 to 1981-85)		
	Area (000ha)	Yield (mt/ha)	Production (000t)	Area (%)	Yield (%)	Production (%)
Sahel	10	8.3	9	3.8	-1.9	1.7
Nigeria	14	2.5	34	1.7	1.7	3.4
West Coast	15	2.4	35	2.0	1.5	3.5
Zaire	14	0.9	13	7.9	0.1	8.1
Central	14	0.9	13	7.9	0.1	8.1
Burundi	10	0.8	8	-0.2	1.4	1.1
Ethiopia	651	1.1	735	-1.6	2.3	0.7
Kenya	112	2.0	222	0.4	2.6	3.0
Sudan	131	1.2	155	8.2	-0.5	7.6
Tanzania	58	1.3	76	5.2	1.3	6.5
Eastern	976	1.2	1,210	-0.4	2.3	1.9
Angola	16	0.6	10	-0.4	-2.7	-3.1
Lesotho	23	0.7	17	-5.3	-0.5	-5.8
Zimbabwe	31	5.4	169	18.4	4.7	24.0
Southern	80	2.8	222	-1.1	6.0	4.8
Total	1,095	1.4	1,489	-0.4	2.7	2.3

*Includes all countries with 1981-85 average wheat area > 10,000 ha.

WATER-USE EFFICIENCY ON COMMERCIAL WHEAT FARMS IN ZIMBABWE

S. Tembo and A. Senzanje[1]

INTRODUCTION

Wheat is grown commercially in Zimbabwe as a fully-irrigated winter crop (May-September) in the highveld, middleveld and lowveld on medium-to-heavy textured soils. Approximately 75% of the commercial wheat farmers are located in the Hunyani and Mazowe Valleys of the highveld (mean elevation of 1442m) and the rest are scattered in the middleveld and lowveld, with a significant concentration in the lowveld (mean elevation of 443m).[2] In Zimbabwe, winter wheat is irrigated by overhead sprinkler systems. Virtually all farmers hand move their irrigation equipment, although about four farmers are experimenting with low-pressure centre pivot systems.

Zimbabwe's wheat industry has grown rapidly over the past 20 years. The first commercial wheat was planted in 1965 in the southeastern lowveld, which marked the beginning of a pronounced increase in wheat production. During the early years, the wheat area expanded mainly in the lowveld, which in 1968 accounted for more than 60% of the country's wheat production (Edwards, 1974). Since 1968, the most rapid expansion has occurred in the highveld. The wheat is grown mainly on large-scale commercial farms, which presently contribute about 94% of the crop. About 4% is produced on state farms, and at most 2% by the communal sector, mostly for home consumption or local markets.

In 1965, Zimbabwe produced only 4,571 mt of wheat, which represented only 4% of its annual wheat consumption requirements. As a consequence of both an expansion of irrigated area--from slightly over 2,000 ha in 1965 to 42,000 ha in 1985--and the release of input responsive varieties; production

[1] Department of Soil Science and Agricultural Engineering, University of Zimbabwe.

[2] The Department of Research and Specialist Services of the Ministry of Agriculture and the Agricultural Research Trust have embarked on research into summer wheat. Many years of research will be necessary to overcome the numerous problems (i.e., rust, low yields, etc.) associated with growing wheat during the summer months. Therefore this paper focuses only on winter wheat.

increased to almost 200,000 mt per year by the early 1980s. Average yields increased from 2.5 mt/ha in 1965 to over 5.0 mt/ha in 1985 (Table 1). These dramatic increases in production have had a marked effect on national self-sufficiency, which increased from 4% in 1965 to the current level of 80%, with a slight surplus in 1975-1976 due to an increase in producer prices and favourable rainfall.

This paper focuses on the commercial wheat sector which includes approximately 470 large-scale commercial wheat farms, with from 30 to 2,000 ha allocated to wheat, but with an average wheat area of 45 ha. The paper draws on the results of a survey of commercial wheat farmers, presented by Longmire, Ngobese, and Tembo at the 1986 conference on Food Security in Southern Africa, held in Harare (Longmire, *et al.*, 1986). After summarizing findings of the wheat survey, the paper reviews current irrigation design methods, scheduling procedures, and the costing of energy and water. Based on this discussion, energy and water saving methods are identified. Available evidence suggests that adoption of the proposed water-saving methods would enable farmers to expand their irrigated wheat hectarages, without investing in new water storage facilities.

REVIEW OF FINDINGS FROM THE WHEAT SURVEY.

In their survey of wheat growers in Zimbabwe, Longmire, Ngobese and Tembo (1986) identified five major points:

- o By 1986 the demand for wheat products had outstripped supply. The major constraint to increasing wheat production was the availability of water.
- o All readily accessible water sources in the wheat-growing areas had been either fully allocated and developed, or restricted for urban and industrial purposes.
- o Despite the obvious water constraint, wheat farmers were not managing water efficiently. Data collected indicated that they seemed to apply more water than needed to carry the wheat crop to maturity (Stewart and Hagan, 1972, 1973).
- o Zimbabwean research institutions have not sufficiently addressed the issue of efficient water utilization in wheat production, perhaps because water has been readily available and cheap, or because demand was not expected to reach the current high level.

Table 1. Zimbabwe wheat production trend, 1965 - 1985, Zimbabwe.

Year	Farm count (large-scale)	Area planted (000 ha)	Yield (mt/ha)	Total output (000 mt)	Domestic consumption (000 mt)	Self suffi-ciency (%)
1965-66	NA	1.7	2.69	4.57	84	4.0
1966-67	NA	4.5	2.23	10.04	108	10.4
1967-68	NA	5.2	2.81	14.61	99	16.0
1968-69	105	7.3	3.37	24.60	109	22.0
1969-70	193	11.4	3.48	39.67	114	33.0
1970-71	198	13.6	3.67	49.91	116	50.0
1971-72	278	20.6	4.02	82.81	119	78.6
1972-73	338	21.9	3.73	81.69	111	78.0
1973-74	276	21.1	3.94	83.13	130	65.0
1974-75	360	25.8	3.71	95.72	141	68.0
1975-76	460	30.6	3.95	120.87	146	88.2
1976-77	491	32.7	4.31	140.94	120	123.4
1977-78	578	41.9	3.93	164.67	125	137.1
1978-79	597	44.8	4.53	202.94	144	147.1
1979-80	464	34.3	4.46	152.98	169	93.8
1980-81	424	32.6	4.75	154.82	205	79.5
1981-82	504	36.6	5.01	183.44	223	89.3
1982-83	485	37.3	5.14	191.72	234	91.1
1983-84	304	21.5	5.16	110.96	227	54.6
1984-85	271	16.9	5.20	87.81	220	44.8
1985-86	371	42.0	5.24	219.99	248	86.5

NA indicates data not available
Source: Adapted from CSO and GMB Data.

- In the analysis of data collected from 45 commercial farms, no strong relationship could be established between net water applied and yield, although the lack of a relationship was perhaps due to measurement error associated with farm survey data.

The Longmire, Ngobese and Tembo (1986) paper concluded that water, not land, is the limiting production factor. Therefore, as water supplies become limited and irrigation and input costs increase, the producers' management objective should shift from optimizing production per unit area to optimizing production per unit of water applied. Optimizing production per unit of water applied implies accepting some yield loss in order to optimize water-use efficiency (WUE)[3].

Longmire's *et al.,* (1986) analysis showed how a farmer can maximize returns to water by applying 440 mm/ha (a total of 176,000 m^3). This would enable him to increase his production from 244 mt on 40 ha to 330 mt on 60 ha through efficient water application. Even after deducting interest and investment costs of expanding the wheat area, net returns would increase from Z$13,370 to Z$21,120 (1986 prices), an increase of over 50%.

The analysis showed that by saving water through "fine tuning" irrigation scheduling, farmers could bring additional land under irrigated wheat without additional water. In conclusion, the authors argued that improved water scheduling is one of the least costly options open for achieving Zimbabwe's stated objective of self-sufficiency in wheat production.

WATER-USE EFFICIENCY.

The two components of water use efficiency are "crop water-use efficiency" and "field water-use efficiency". Crop water-use efficiency is the ratio of crop yield to the amount of water depleted by the crop through evapotranspiration. Field water-use efficiency is the ratio of crop yield to the total amount of water used on the field. The two differ by the amount of water applied to the field, but never utilized by the crop (e.g., losses due to evaporation and drainage).

In Zimbabwe, with the ever-increasing demand for wheat products and scarce water resources for irrigated wheat, it is imperative to maximize water-use efficiency. At the research level, there is the need to better understand the relationship between water consumption and crop yield. At

[3]Water-use efficiency is defined as wheat yield per unit of net water applied kg/mm.

the farm level, knowledge of the influence of soil water management on plant growth is necessary to maximize output from a given water input.

Research must address several important issues to understand and enhance farm level water-use efficiency. Research directed at increasing wheat production with limited water resources would allow farmers to save water, thus enabling them to irrigate additional wheat area. Finally, research should focus on saving energy (e.g., electricity for pumping water) through improved irrigation management.

Irrigation scheduling

Irrigation scheduling is the technique or process by which the timing and amounts of irrigation water applications are determined. Irrigation scheduling provides a set of guidelines to farmer which indicate when to irrigate, how much water to apply, and how to apply it. At the farm level, proper scheduling can increase the productivity of water and result in considerable savings of water, energy, and labour.

It is of paramount importance that farmers view irrigation scheduling as a flexible management tool to increase their profits, not merely as an exercise. Interviews with farmers suggested that irrigation scheduling, as practiced in Zimbabwe, falls far short of being a management tool. Since scheduling is viewed by many farmers as a routine task to be carried out at regular intervals, many farmers make little effort to schedule in response to crop needs, resulting in low water-use efficiency.

Improper scheduling persists for several possible reasons, including:

- o Water is too inexpensive for farmers to worry about conserving it.
- o Pumping and energy costs are low.
- o Farmers lack the know-how to implement scientific scheduling.
- o Farmers do not want to be bothered with a management practice that appears academic.
- o There has been inadequate research carried out in Zimbabwe to show farmers the benefits of improved water management.
- o The marginal benefits from improved scheduling appear minimal and are not obvious, compared to the extra effort required.

If water-use efficiency is to be improved through scheduling, all, or at least some of the above items, have to be corrected through well-designed research and extension. On the research side, there is a need for adaptive research that replicates work done elsewhere, to produce results relevant to local conditions (e.g., critical growth stage scheduling and deficit irrigation). Results from the proposed adaptive research will enable farmers to fine tune their irrigations and increase water-use efficiency. No matter how well an irrigation system is designed, if water management is poor, the system's performance is lowered with subsequent reduction in water-use efficiency.

Yield response to water

Research carried out in the United States on wheat yield response to water applied (Stewart and Hagan, 1973) suggests a curvilinear relationships where yields first increases linearly with increasing amounts of water. After a certain level of water applied, the yield response to increasing amounts of water decreases, until finally there is no response to additional water. If excessive water is applied, yields decrease due to soil saturation.

Unfortunately, it is difficult to predict yield response to water because water application rates are a poor measure of water-use rates by the crop--water application rates are subject to many uncontrollable variables. Consequently, empirical results tend to be site specific and nontransferable. A more dependable parameter to estimate water use is evapotranspiration (ET). Unfortunately, since ET is very difficult to quantify, farmers are unlikely to use it in irrigation management. Research is needed to determine the optimum amount of water required to carry a crop to maturity under varying climatic and soils conditions, as well as under different irrigation regimes.

Water production functions.

At the regional level, resource planners need a clear understanding of how overall crop production patterns vary as a function of water availability, if they are to properly manage regional water supplies. When water becomes scarce and/or the cost of irrigation water rises, planners and farmers need to know how to best adjust cropping patterns such as by decreasing area under crops that use too much water, or by applying less water to more drought-resistant crops.

Water production functions, which relate water availability to output, may be applicable on a regional basis to determine optimal utilization and allocation. They are most useful as a planning guide in the following three cases:

- land is limited, but water is available (at a price).
- irrigation water is limited, but land is available.
- both water and land are limited.

Research by Longmire *et al.*, (1986) reports that the second case applies to Zimbabwe. When water is scarce, the management objective should shift from maximizing net returns per unit of land to maximizing net returns per unit of water (Stewart *et al.*, 1973).

Additional research is needed to estimate production functions with reliable predictive capacity (i.e., valid over a wide range of conditions). Farm level data is of limited use for estimating these functions because it is impossible to control factors such as soils, crop variety, sowing dates, and management.

Research done in the United States has shown that water production functions are polynomial in nature (Stewart *et al.*, 1973; Yaron, 1971). Yaron obtained a quadratic function of the form:

$$Y = a + bW - cW^2 \qquad [1]$$

where:

Y = yield (mt/unit area)
W = water applied
a,b,c = constants

This function is particularly appropriate because it takes into account the detrimental effects of excess water application.

A second function which can be fitted is the Mitscherlich-Spillman function:

$$Y = a\{1 - e^{(-cw)}\} \qquad [2]$$

where:

Y = yield
a = maximum yield when W is used to the limit
W = water applied
c = constant

A shortcoming of this function is that it does not take into account the injurious effects of excess water application. It assumes that as W is increased successively, Y becomes asymptotic to a.

To compensate for this deficiency, the Spillman function may be improved by adding "injury" factors (k), so that it becomes:

$$Y = a\{1 - e^{(-cW)} * e^{(-kW)}\} \qquad [3]$$

Water production functions are of limited value unless they are estimated from properly designed experiments. On-station trials are needed in Zimbabwe to allow researchers to test a wider range of water application levels than could be analyzed by relying exclusively on farm survey data. If developed from properly designed experiments, water production functions are very powerful tools which, for example, would enable extension agencies to develop more effective irrigation-scheduling recommendations. With the availability of computers and simulation models, it is now possible to estimate these production functions with considerable accuracy and incorporate a variety of critical variables.

Additional irrigation research needs

Several complementary studies should be carried out in Zimbabwe to fill gaps in irrigation systems research.

Critical growth stage irrigation

Under this strategy, water is applied only at crop growth stages during which a water shortage reduces yield. The method is applicable in deep soils where the soil is filled to field capacity at planting. For wheat, this implies that the crop is first irrigated at planting, followed by irrigations at booting, flowering, and finally at grain filling (Salter *et al.*, 1967). Critical growth stage irrigation stretches the limited water supply without overly compromising yield. Research to evaluate this water application method would not require additional capital investment. Research institutions, such as the Agricultural Research Trust (ART) farm (just outside Harare in the highveld) and the Chiredzi Research Station (in the lowveld) are currently conducting research on some aspects of critical growth stage irrigation. These important initiatives need to be continued and expanded.

Evapotranspiration deficit irrigation

Under this scheduling procedure, the soil profile is filled to field capacity at planting. Low soil moisture deficits are maintained in the early season, when the pumping capacity of the irrigation system can satisfy ET requirements. Then, in the peak stress period, the crop is irrigated more frequently to maintain high soil water potential in the top of the root zone. During grain filling, the soil is irrigated to field capacity. This method is applicable to Zimbabwe, especially in deep soils with moderate-to-high water-holding capacity. Also, farmers can use this method in irrigation systems where it is possible to apply frequent irrigations in controlled amounts (Fonken *et al.*, 1974). To effectively implement this method, research is necessary to develop computer simulation models to determine the probable yield loss risks for the various combinations of pumping capacity, soil types, and crops.

Stress day index method

Under this semiquantitative irrigation strategy, irrigations are initiated when a calculated stress day index (SDI) approaches a defined critical level in specified growth stages (Hiller and Clark, 1971). The SDI is determined as:

$$SDI = \sum_{i=1}^{n} (SD_i * CS_i) \quad [4]$$

where: n = number of growth stages considered
SD_I = degree and duration of plant water deficit in growth stage i
CS_i = crop yield susceptibility in crop growth stage i at that water deficit level

The SDI can be calculated daily, at each growth stage, or for an entire season. Research done in the United States showed that higher water-use efficiencies are obtained using this scheduling strategy, compared to other methods.

OVERHEAD SPRINKLER IRRIGATION DESIGN IN ZIMBABWE

Most old sprinkler irrigation system designs, and even many of those currently being installed, are based on a "peak water requirements" design philosophy which assumes cheap water. The decreasing availability of water will require a design revolution, if Zimbabwe is to realize the government's stated wheat self-sufficiency objective.

To effect this revolution, additional agronomic research is required to investigate the yield response of wheat to water. This research is needed to identify how much water must be applied and at what critical crop growth stage; and in some cases, how that water must be applied. For example, engineers need to know whether well-watered wheat plants use more water per unit of dry matter than plants subjected to stress at various stages. Most Zimbabwe wheat farmers believe that the wheat crop should never be stressed during its growth. Yet, considerable research evidence from United States indicates that moisture stress at certain growth stages does not appreciably reduce yields (Neghassi, *et al.*, 1975). In a detailed study of wheat irrigation with limited water, Schneider *et al.*, (1969) showed that water stress before booting had a negligible impact on yield. On the other hand, water stress during heading-to-grain formation reduced yield. A related study (Hurd, 1968) showed that slight crop stress promoted root development; which allowed the crop to use a larger soil reservoir, thus enhancing greater water-use efficiency.

These studies provide design engineers with the information required to design flexible irrigation schemes that accommodate the crop's varying water requirements at the different growth stages. With such information, engineers can design schemes for deficit irrigation--the practice of deliberately stressing a crop. This practice is particularly attractive for Zimbabwe in light of limited water supplies and rising irrigation costs. Deficit irrigation allows farmers to greatly reduce water and energy use without reducing net income. Viewed in another way, it will increase their incomes without significantly increasing water and energy use.

The latter is particularly applicable to farmers with fixed water allocations from free-flowing rivers or public dams. Deficit irrigation implies accepting some level of crop stress, imposed through long irrigation intervals and reduced soil-moisture uniformity. Engineers control both of these phenomena through the design of the irrigation system.

Irrigation frequency directly affects the capital (fixed) and running (variable) costs of irrigation schemes. In hand-moved overhead sprinkler systems (as are predominantly found in Zimbabwe) that employ high irrigation frequencies, more laterals may be required to cover the command area--implying higher capital and maintenance costs. In this case, reductions in capital, running, maintenance, and labour costs could be realized by designing systems for low frequency irrigations. With the proposed low frequency deficit irrigation, moisture levels would be allowed to fluctuate over a wide range. A heavy irrigation at a critical growth stage would be followed by a long moisture extraction period, during which the crop would be stressed at some less yield injurious stage. A subsequent irrigation would refill the profile to field capacity. This process would be repeated over the crop growth range. This proposed approach differs from current practices in Zimbabwe in that it recognizes the different crop water requirements at different stages of growth, seeks to reduce net water applied, and conserves energy.

The efficiency with which irrigation systems store water in the root zone (water storage efficiency) depends on two design parameters; namely the uniformity coefficient and the irrigation adequacy. The uniformity coefficient measures the uniformity pattern of irrigation water applied. Irrigation adequacy measures the percentage of the command area refilled to field capacity during an irrigation. Standard irrigation designs seek to optimize both factors. However, a study by English *et al.*, (1982) showed that water storage efficiency was increased from approximately 77%-92% even though adequacy was reduced from 82-50%. In other words, higher storage efficiency is possible at lower adequacy levels. This suggests that improved systems designs can save both water and energy.

IRRIGATION ENERGY COSTS IN ZIMBABWE.

As noted earlier, standard irrigation design and scheduling methods used in Zimbabwe waste water and require high capital and running costs. Farmers surveyed by Longmire *et al.*, (1986) reported that electricity costs are a major cost component in their wheat production systems. Electricity is sold to farmers through a tariff that is characterized by a declining block rate, which encourages consumption. Against this background, this section highlights energy-saving practices that would produce benefits to farmers.

Farmers tend to over-irrigate to prevent crop yield reduction. However, several irrigation-scheduling trials have demonstrated that a reduction in water applied may, in some cases, actually improve wheat yields in Zimbabwe (MacRobert and Mutemeri, 1987). It is obvious that any reduction in water pumped will reduce energy consumption, even if no other changes are made in the irrigation system.

Energy use in irrigation is a function of numerous parameters, including design flow rate, pumping lift, net irrigation, irrigation system efficiency, management practices, and the type of irrigation system. Pumping energy (PE) requirement is given by (Batty *et al.*, 1975):

$$PE = c*A*D*H/E*Ep \qquad [5]$$

Where:

PE	=	pumping energy (kW hr)
A	=	area irrigated (ha)
D	=	net depth irrigation (mm)
H	=	total dynamic pumping head (m)
E	=	irrigation efficiency
Ep	=	pumping efficiency
c	=	conversion factor for units (0.0271 for SI units)

This relationship shows that the PE can be reduced by:

- o reducing net depth of irrigation through proper scheduling and management practices;
- o increasing irrigation efficiency through proper system management;
- o reducing total dynamic head through proper design and pipe selection; and
- o increasing pump efficiency through proper design and pump selection.

The combined effects of changes in D, H, Ep, and E is evaluated by the following relationship, developed by Gilley and Watts (1976):

$$PES = \{(PE_1 - PE_2) * 100\} / PE_1 \qquad [6]$$
$$= [1-(D_2/D_1)*(H_2/H_1)*(Ep_1/Ep_2)*(E_1/E_2)]*100$$

Where:

PES = the potential energy savings (% relative to before and after changes in each parameter)[4]

Gilley and Watts (1976) argue that realistic potential coefficients for variables in this model are: $D_2/D_1 = 0.8$, $H_2/H_1 = 0.85$, $Ep_1/Ep_2 = 0.87$, and $E_1/E_2 = 1.0$. At these values, energy is reduced by 41%. Without a pressure reduction or change in total dynamic head (i.e., $H_2=H_1$), an energy saving of 32% is possible.

Most of the energy used in irrigation is consumed by the pumping unit. Although no pump tests were carried out during the 1986 wheat survey, we believe that many of the pumping units in Zimbabwe are operating well below their design-pumping efficiencies, due to very poor service and maintenance.[5] In many cases, pump efficiencies are may be below 50%, which is highly wasteful of energy.

Reduced pumping heads decrease energy requirements by reducing the energy required to push the water to the required elevation. In most cases, nothing can be done to change the elevation factor, as it is a function of land and terrain. Yet, it is possible to reduce the pumping head and energy requirements through proper pipe size selection.

IRRIGATION TECHNOLOGY

Hand-moved equipment is labour intensive. A high level of labour intensity influences irrigation set time and introduces rigidity in field level irrigation management. Set time is the irrigation time required to refill the root zone to the design moisture level, usually to field capacity. Most hand-moved systems are designed for a set time of 11 hours. This allows the farmer to

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[4]Subscripts 1 and 2 denote before and after values of the other parameters, respectively.

[5] Pump operational design life is normally 10 years. However, a leading irrigation design firm in Harare estimates the operational life on typical farms as low as 5 years (50% lower), due to the general lack of spares (bearings in particular) and poor maintenance.

change the lateral positions twice a day, generally at 6:00 am and again at 6:00 pm. This saves labour for the farmer, as he does not need to employ an overnight crew to move the laterals. However, even though many farmers follow this practice to save labour and for convenience, in most cases it is introduced at the expense of agronomic factors that might increase yield and, in some cases, save water.

Centre pivot irrigation systems that operate at low pressure offer reduced pumping costs (as much as 30%), facilitate precise water application, and--more importantly--allow flexibility in irrigation set time. The major disadvantage of centre pivot systems is their high initial cost, substantially greater than line irrigation systems. However, these automated systems make it possible to more accurately schedule irrigation water to meet actual plant requirements. Consequently, in the long-run, they save both water and labour. The four farmers experimenting with centre pivots systems claimed greater management flexibility, as well as savings in water applied and energy costs, compared to their hand-moved systems.

We believe that the adoption of computer based water scheduling for winter wheat would yield significant water and energy savings, even on hand-moved systems. A precedent has been set by the Zimbabwe Fertilizer Company which has introduced a computer based package for irrigation water scheduling. Initially launched to increase fertilizer sales, the wheat survey (1986) reported wide adoption of this package. Farmers regard it as a cost-reducing technological innovation with great potential for increasing water-use efficiency.

Centralized computer based scheduling, as proposed by Corey and Franzoy (1974), would provide farmers daily data to assist in making irrigation management decisions. This service could be located at the Agronomy Institute, Department of Research and Specialist Services, or at the ART farm. Farmers would phone in every morning giving agronomic (i.e., soil type, crop growth) and climatic data (i.e., location, rainfall, evapotranspiration) from the previous day. The data would be fed directly into the computer through a dedicated telephone line. Then, the computer would calculate when to irrigate next, how much water to apply, etc. This is a low-cost option to the farmer, since he would pay only for the computer service. The capital and ownership cost of the computer could be borne by the state or by a farmers' organization. In addition, the farmer would not have to be computer literate and would be freed from making mathematical calculations.

Yet, centralized computer scheduling requires:

- a good data base on soil-crop-water relationships;
- reliable climatic data;
- computer expertise to implement the system; and
- a reliable telecommunications system.

Most of the above conditions are either lacking or are at an infant stage in Zimbabwe; and would require further development before these technological benefits can be realized.

CONCLUSION

Increasing water-use efficiency would enable Zimbabwe to become more self-sufficient in wheat production. To achieve this objective, several constraints must be overcome.

Expanding the research data base

Most of the cost-saving methods outlined in this paper could be adopted and implemented in Zimbabwe if not for the lack of one critical factor--a research data base. Irrigation research in general, and irrigation research on wheat in particular, has only begun in Zimbabwe. Ongoing varietal improvement research trials at both the ART farm and the government research stations are commendable, but may have reached the point of diminishing returns. Wheat yields in Zimbabwe already are among the highest in the world. A recently released local variety, Sengwa, yielded 10 mt/ha under station conditions at Harare Research Station. Researchers must now focus their efforts on improving water-use efficiency by, for example, providing guidelines to farmers on how to increase wheat production through more efficient utilization of the two limiting resources, water and energy. We must not ask the farmers simply to produce more wheat; rather, we must ask them to "efficiently" produce more wheat. Before farmers will adopt new technologies, convincing evidence of the benefits under Zimbabwean conditions is needed. Irrigation research is needed that investigates the agronomic, technical, and economic aspects of new wheat technologies. Therefore, it requires the collaboration of breeders, agronomists, and engineers; and provides an excellent opportunity for stronger cooperation between public and private sector institutions.

Cost of electricity.

As previously indicated, the cost of electricity is directly related to the type of irrigation system. Centre pivot systems, which operate at lower operational pressures, offer significant electrical energy savings over conventional high pressure systems. Although farmers cite electricity as one of their major cost, they still find it uneconomic to invest in automated, low pressure systems--especially since labour is still cheap.

In Zimbabwe, electricity is priced using a declining block rate that encourages consumption. On the one hand, this is justifiable for expanding power supply systems where the long-run marginal cost of generating electricity is declining (when each new plant brought on or an extension of a line lowers costs because fixed investment is spread over more units of output). On the other hand, time-of-use pricing (offering discounts during off-peak hours when overall demand is lowest) would encourage farmers to conserve energy. Introducing time-of-use pricing would require no extra capital cost to the electricity suppliers and would encourage farmers to avoid power usage during peak industrial use when it is expensive. This is feasible in automated irrigation systems, where time of day puts no operational constraints in the system.

Costing of water

Irrigation water in Zimbabwe is priced too low to encourage farmers to adopt practices that improve water management. Longmire *et al.*, (1986) showed that the pattern of water application reflected source and cost of water, which was often determined by institutional factors. Farmers who did not pay, or paid relatively less than others for water, were more wasteful; they applied a lot more water than is required to grow a wheat crop to maturity.

The current blend price of public water (Z$10-18/1,000 m^3) is subsidized and tends to encourage waste. Agronomic research is required to establish the optimal amount of water required to grow a wheat crop (mm/ha or m^3/ha), and a new water tariff must be established that penalizes farmers who apply more than the optimal water level. The system should credit those who save water and at the same time, maintain optimal yields. This could be effected by transferring whatever water volume a farmer has saved into the next season.

To enforce this system for all public water, the Regional Water Authorities would have to install user flow meters and additional manpower to enforce compliance. Water savings from this institutional restructuring could be used to help pay for the capital invested and the management required to maintain the system. In the long-run, farmers may find it attractive to allocate the saved water to increase their wheat area.

Irrigation management.

Currently, irrigation management in Zimbabwe is more of a tradition than a science. Farmers have not had to modify management practices in response to growing scarcity because the scarcity is not reflected in water and energy pricing. In the main, farmers continue to accept "rule of thumb" irrigation-design recommendations based on peak water requirements; and they continue to move the laterals twice a day because it is convenient. Their behavior is understandable; they have been exposed to little empirical evidence showing the benefits of alternative strategies, and they are subject to few economic disincentives to alter these established practices. Additional research would help to generate such evidence. Finally, pricing policies oriented toward water and energy savings would encourage irrigation designers to be innovative in developing water efficient systems and, at the same time, would force farmers to more efficiently manage Zimbabwe's scarce water resources.

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THE ECONOMICS OF EXPANDING COMMERCIAL WHEAT PRODUCTION IN ZIMBABWE

P. T. Ngobese[1]

INTRODUCTION

Zimbabwe produces 150,000-240,000 mt of wheat annually, depending on the rainy season (Pilditch, 1987). In contrast, the annual demand for wheat based products is presently estimated between 300,000-360,000 mt. Thus, the country has an annual shortfall of at least 100,000 mt which has to be imported. In recent years, wheat imports have taken the form of aid-assisted triangular transactions in which the country's surplus maize is exchanged for wheat. The barter trades have masked the fact that Zimbabwe would have had to pay US$10 million annually for wheat, if it had been imported commercially (based on an export price of US$100/mt). For the whole SADCC region, the commercial value of wheat imports is estimated at US$70 million annually.

Since all of the SADCC countries are experiencing the same trend of rising wheat consumption and imports, the problem of increasing wheat production extends beyond local interest when the regional dimension is considered (Thompson, 1986). In order to become self-sufficient in wheat, SADCC countries would have to invest in their domestic wheat production sectors considerably more than the value of annual imports. The form of this investment is very much tied to the respective country's agrarian structure. In the case of Zimbabwe, most investment in wheat production has been made in the large-scale commercial farming sector.

This paper analyses data collected during a 1986 survey of 41 commercial wheat farmers in examining some of the issues associated with the policy objective of increasing wheat production (Longmire, Ngobese and Tembo, 1986).

EVOLUTION OF THE WHEAT INDUSTRY

Wheat production in Zimbabwe has been closely associated with the development of the wheat-processing industry. For example, the introduction of the

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first dough mixer at a local bakery in 1927 was followed by government measures to encourage bakers to use local wheat. In 1928, a rebate on customs duties on imported wheat was introduced. Millers were eligible to receive the rebate if they blended imported wheat with at least 20% locally grown wheat. Persistent calls by the domestic processing industry for improved quality in the local crop pressured the government to direct resources toward the wheat sector. Partly in response to this pressure, the Department of Agriculture initiated a local wheat-breeding programme in 1931 (Weinmann, 1975).

Production of wheat slowly expanded with the areas planted to wheat increasing from 1,832 ha in 1925 to 8,332 ha in 1935. But the Natural Resources Board's insistence on banning riverine wetland *(dambo/vlei)* cultivation of wheat--at that time the conventional cultivation environment--subsequently led to a decline in the area grown in the post-war period.

The expansion of wheat production as a large-scale commercial sector crop was facilitated by both the development of irrigation following completion of the Kyle Dam in 1961, together with the introduction of sprinkler irrigation technology. The imposition of sanctions in 1965, curtailing commercial grain imports, gave impetus to the government's policy of assuring self-sufficiency in basic food grains production. This served to reinforce the trend towards large-scale irrigation development, particularly for wheat, since virtually all wheat had previously been imported. The liberal capital development subsidies provided by the Farm Irrigation Fund made it possible for the country to move from a wheat deficit situation before the *Unilateral Declaration of Independence* (UDI) to an actual surplus during 1976-78. However, since 1980 the demand for wheat has once again outstripped the supply.

WHEAT PRODUCTION STRUCTURE AND RESOURCE USE

Table 1 shows the distribution of farms in Zimbabwe; classified according to the area under wheat, the proportion of the total wheat area, and the proportion of total production contributed by each size class.

Seventy percent of Zimbabwean wheat operations have less than 100 ha planted to wheat. However, this group of small operations represents only 32% of the total area planted to wheat and accounts for only 30% of the total quantity produced. In contrast, the remaining 30% of large operations, with an area planted to wheat above 100 ha, accounts for 68% of the total wheat area and 70% of total production.

Differential access to resources--particularly water and capital--appears to influence the size of wheat operations and may account for the size

Table 1. Size distribution and output of wheat operations in Zimbabwe, 1987.

Wheat area of farms (ha)	Total no. area (%)	Total wheat production (%)	Total wheat (%)
1 - 20	14	3	2
21 - 100	56	29	29
101 - 200	20	29	30
>201	10	39	40

Source: CSO (1987).

heterogeneity shown in Table 1. For example, the nature of the water source (e.g., flow right to a "public" river, private farm dam, borehole) affects how much wheat can be irrigated. Approximately 40% of the wheat farmers surveyed in 1986 (Longmire, Ngobese and Tembo, 1986) cited private farm dams as their major water source. Only 23% possessed a flow right to a "public" river, and 18% obtained water from government dams. The rest owned boreholes or shared a private dam with other farmers. On average, farmers with their own private water supply planted a larger area to wheat. Although privately-owned water is generally more expensive than "public" water, the greater availability and reliability of private water enables farmers possessing their own water source to plant greater areas.

Restricted access to capital also appears to influence the size of wheat operations. In comparison with other commercial crops grown in Zimbabwe, wheat is relatively capital intensive in that it requires full irrigation and a high degree of mechanization (e.g., combine harvesting). Expansion of wheat area consequently requires considerable capital investment as well as access to imported machinery, both of which presently pose problems. Most wheat farmers reported that the modest profitability of wheat does not justify investment in irrigation, unless wheat is grown in rotation with other high value crops. Furthermore, the availability of agricultural machinery needed to grow wheat has been severely restricted by the current foreign exchange shortage, indicated by the fact that the average age of combine harvesters owned by the survey respondents was eight years.

PROFITABILITY OF WHEAT PRODUCTION BY SIZE OF OPERATION

Data generated by the 1986 survey of commercial wheat farmers were used to construct enterprise budgets, based on 1985 prices (Ngobese, 1987). Given the size heterogeneity of wheat operations, particular attention was directed to the question of whether wheat production is most profitable at a particular size of operation. Therefore, the survey respondents were grouped into 10 size classes, with the objective of calculating the optimal size of a wheat operation. Representative budgets were constructed for each size class. Table 2 summarizes the variation in net returns, by size of operation. (See Ngobese, 1987 for the complete set of budgets).

Table 2. Net returns by size of wheat operation, 1986, Zimbabwe.

Size of operation (ha)	Average: total costs (Z$)	Average: net returns (Z$)	Break-even yields (t/ha)	Average net returns to: Water (Z$/mm)	Average net returns to: Labour (Z$/hr)	Average net returns to: Working capital (Z$)
Highveld						
20 - 40	1,227	232	4.3	2.17	1.53	4.53
41 - 79	1,333	525	4.7	3.46	3.59	7.04
80 - 100	1,261	460	4.4	3.34	5.00	7.94
101 - 139	1,185	519	4.2	4.46	3.32	9.25
140 - 160	1,146	562	4.0	4.61	4.28	10.04
161 - 199	1,191	668	4.2	4.26	5.35	11.39
847[a]	1,021	489	3.6	3.75	3.41	9.81
Lowveld[b]						
200	808	189	2.8	2.04	2.75	5.37
440	974	288	3.3	2.54	5.22	6.63
1975	977	(7.67)	3.4	0.95	0.94	0.86

[a]A single corporate farm
[b]single farms
Source: Wheat farm survey

It is difficult to directly compare highveld and lowveld wheat operations since climatic conditions, input use levels, and yields differ considerably. These differences are reflected in the fact that production costs are generally lower in the lowveld. However, it is interesting to note that the pattern of average total costs behaves differently as the size of the wheat operations increases. On the highveld, total costs per hectare decline with size of operation over the entire range of farm sizes surveyed. In contrast, in the lowveld total cost per hectare increase with size of operation over the limited range of farm sizes surveyed. This is reflected in the downward trend in the break-even yield as wheat area increases on the highveld. In contrast, in the lowveld, the trend is upwards. (The break-even yield is the yield at which gross revenue just covers total costs).

While policy makers may be most interested in producing wheat at minimum cost, farmers are more concerned with profitability, as measured by net returns per hectare. Table 2 indicates that on the highveld, net returns per hectare increase with increasing size of operation up to the 180 ha operation, beyond which they decrease. On the lowveld, net returns per hectare increase with increasing size of operation up to the 440 ha operation, beyond which they decrease as well.

Conventional profitability analysis, which measures net returns per unit area, implicitly assumes that land is the limiting factor of production. In cases where other factors are limiting, it is instructive to examine the net returns to other factors of production. As part of the profitability analysis of different sizes of wheat operations, net returns were also calculated to water, labour, and capital (Table 2).

On the highveld:

- o Net returns to water increase with increasing size of operation, up to the 150 ha operations, and decrease thereafter.
- o Net returns to labour show no consistent pattern.
- o Net returns to working capital increase with increasing size of operation, up to the 180 ha operations and decrease thereafter.

On the lowveld:

- o Net returns to water increase with increasing size of operation, up to the 440 ha operation, and decrease thereafter.
- o Net returns to labour increase with increasing size of operation, up to the 440 ha operation, and decrease thereafter.
- o Net returns to working capital increase with increasing size of operation, up to the 440 ha operation, and decrease thereafter.

The observed decreasing average costs of production and increasing net returns as the size of wheat operation increase suggest there are economies of size in wheat production in Zimbabwe. Thus, the analysis suggests that wheat production is a viable enterprise for larger operators, as they are able to spread their fixed costs (e.g., machinery, irrigation) over a large production base. Furthermore, the data suggest that the profitability of wheat farming is optimised at a farm size larger than most farms in Zimbabwe.

REGRESSION ANALYSIS TO DETERMINE OPTIMAL SIZE

Analysis of the optimal enterprise size was further explored through regression analysis. Because the survey sample included only three wheat farms located in the lowveld, subsequent statistical analysis was restricted to the 38 wheat farms located on the highveld. Ordinary least square estimation of a quadratic response function relating net revenues to size of highveld wheat operations gives the following results:

<u>Model 1: Net returns per hectare</u>

$$NR = 232.43 + 2.89\ AWT - 0.003\ AWTSQ$$
$$(2.86)^{*}\ (3.52)^{*}\ (-3.47)^{*}$$

Adjusted $R^2 = 0.63$. $F = 6.18$

where:

NR	=	net returns per hectare
AWT	=	wheat area
AWTSQ	=	what area squared

t-statistics given in brackets under parameter estimates
* significant at the .05% level.

The wheat area which maximizes net returns (per unit area) is calculated by differentiating the net revenue regression equation with respect to the area of wheat; and setting the first derivative equal to zero. Using this approach, the wheat area which maximizes net revenues on highveld farms equals 481.66 ha.

Optimality, defined in terms of maximizing net returns, represent the farmer's point of view; since it is generally assumed that profit maximization is a primary goal of farmers. An alternative way to consider optimal size is in terms of the country's point of view (i.e., in terms of minimizing wheat production costs). Ordinary least square estimation of a quadratic response function relating average total costs to size of highveld wheat operations gives the following results:

Model 2: Average total costs of production

ATC = 41.52 - 0.269 AWT + 0.0003 AWTSQ
(7.11)* (-4.55)* (4.13)*

Adjusted R^2 = 0.81, F = 13.91

where:

ATC = average total costs of production per hectare
AWT = wheat area
AWTSQ = what area squared

t-statistics given in brackets under parameter estimates
* significant at the .05% level.

The wheat area which minimizes average total costs (per unit area) is calculated by differentiating the average total cost regression equation with respect to the area of wheat, and setting the first derivative equal to zero. Using this approach, the wheat area which minimizes average total costs of production on highveld farms equals 448.3 ha.

These regression results suggest that there is little difference in the optimum size of operation, considered from the farmer or the national point of view. Because the survey sample included only a limited number of wheat operations in the larger size categories (>200 ha), reflecting the actual composition of the population, it is unwise to place too much confidence in the specific figures generated by the optimization calculations. However, the analysis suggests that the size of wheat operation which maximizes net returns and average total costs of production is considerably larger than most wheat operations in Zimbabwe.

CONSTRAINTS TO INCREASED PRODUCTION

Zimbabwe will face several difficulties in attempting to increase wheat production.

Difficulty of achieving optimum size

The data presented above suggest that economies of size in wheat production are not being fully exploited in Zimbabwe.

Irrigation constraints--for example, the limited availability of water and the high capital costs of developing an irrigation scheme--are major factors why the size of most wheat operations is suboptimal. Another factor explaining the suboptimal size of wheat operations is that the choice of summer crops largely (and by implication, the crop rotations) determines the area grown to wheat. Summer crops such as maize, tobacco, cotton, soyabeans, and groundnuts are often the main cropping enterprise, with wheat of secondary importance. Consequently, the area planted to wheat is determined residually, after the farmer has committed himself to his summer crop(s).

Cost of irrigation

The budgets indicate that irrigation costs (water storage, irrigation equipment, and pumping costs) are the most expensive production inputs. A sprinkler irrigation scheme costs on average Z$3,000/ha, with an additional Z$3,000/ha required for water storage. It is apparent that farmers are not willing to pay the full private costs of this development, at least not for wheat production alone. A substantial proportion of this cost may have to be borne by public expenditure, as evidenced in the subsidy provided by the National Irrigation Fund (NIF) and state farm operations set up under the Public Sector Investment Programme. For example, the NIF provides loans for private irrigation development at a subsidized interest rate of 9.75%, as compared to the Agricultural Finance Corporation loan rate of 13.9% and a commercial bank rate of 16-18%. The NIF loans are conditional on the recipients growing a certain hectarage of wheat. Up to 6,000 ha of wheat have been brought into production since 1984 when the fund was established.

Despite the high cost of irrigation, there are opportunities to achieve savings on irrigation costs through improvements in application efficiency (Longmire, Ngobese and Tembo, 1986; Tembo and Sezanje, 1987). Yet, because increasing irrigation efficiency is expensive, farmers apply excess water rather than make the additional investments to increase efficiency, especially if they continue to earn profits (LeBaron and Keller, 1986). Since maximizing yields does not necessarily mean maximizing profits, wheat farmers may be able to increase profits by planting a larger area and settling for lower yields (Longmire, Ngobese and Tembo, 1986),

Farmers are generally less efficient in their irrigation scheduling in water surplus situations. But in situations where there are water shortages, farmers are automatically forced to try to make efficient water-use decisions (LeBaron and Keller, 1986). Typically, they vary the area planted to wheat in order to optimise the value of water. This means deciding how much land to leave unplanted in order to concentrate expected water supplies on the remaining land. While wheat production inevitably will decrease in times of drought, the increased attention paid by farmers to water allocation may mitigate the production decrease.

Lack of material for summer wheat production

One major constraint to expanding wheat production in Zimbabwe is the lack of materials suited to the summer growing season. The future success of rainfed summer wheat production will depend on the outcome of ongoing breeding programmes which are seeking to develop disease and drought tolerant cultivars. Hypothetical budgets suggest that while yields as low as 2 mt/ha may enable farmers to cover variable costs of production, yield of at least 3 mt/ha are needed to make summer wheat competitive with other summer crops (Morris, 1987).

CONCLUSIONS

Zimbabwe has achieved significant progress over the past 20 years in increasing its level of wheat self-sufficiency. The marked increase in wheat production has been made possible by an incentive producer price, extensive investment in irrigation, and the adoption of high-yielding wheat varieties. Nevertheless, the fact that in recent years wheat consumption has increased more rapidly than production, underlines the need to expand wheat production at an even faster rate in the future.

This paper has examined the economics of wheat production on commercial wheat farms, with the goal of identifying constraints to expanding production in the future. Regression analysis of enterprise budget data revealed that most commercial wheat operations are of suboptimal size, in the sense that net returns to wheat production could be increased (and average total costs lowered) if cultivated area perform was increased. This suggests that the efficiency of wheat production could be increased by increasing area planted to wheat on each farm. Since area planted to wheat typically represents only a portion of total farm size, this would seem feasible in Zimbabwe. Furthermore, any future structural change that results in a decrease in the average size of wheat operations might conflict with production efficiency and lower the profitability of wheat. This seems to have happened in Kenya. Where wheat-producing land has been parcelled out to smallholder farmers, there has been a shift out of wheat production into maize production.

The lack of suitable material for summer wheat production (and the disease problems associated with summer wheats) implies that future production increases will probably have to come from an increase in irrigated area. Based on current demand levels, the cost of self-sufficiency in wheat for Zimbabwe will include the cost of bringing under irrigation an additional 24,000 ha (assuming no change in yields), representing an additional investment of Z$144 million at current prices. This means new irrigation investment will have to be undertaken at a rate of 3,000 ha per year. At this annual rate of expansion, by the year 2000, the total irrigated area of wheat would be 72,000 ha. At an average yield of 6 mt/ha, Zimbabwe could produce 432,000 mt of wheat, just short of the project demand of 600,000 mt.

Increasing irrigated area at an annual rate of 3,000 ha obviously will be extremely costly. The relatively modest profitability of wheat suggests that farmers are unlikely to bear the full cost of irrigation investment for wheat alone, unless producer prices are raised to unsustainably high levels. But returns to irrigation investment could be increased in at least two ways. First, considerable scope exists for increasing the efficiency of water application. Second, farmers can more fully exploit their irrigation systems through innovative management practices aimed at maximizing returns across the entire crop rotation (e.g., by taking advantage of complementarities between crops). Plant breeders also have an important role to play in this respect. For example, by developing varieties that can be harvested early or planted late, they can reduce the conflict with other crops in the rotation.

Domestic wheat production in a tropical environment is generally a high cost option (Andrea and Beckman, 1985), although experience elsewhere in Africa indicates that wheat can be profitable when grown as a second, or even a third crop in a multiple crop rotation. Domestic resource cost analysis suggests that this is the case for Zimbabwe, since the cost of irrigation investment can be spread across several summer crops (Morris, 1987). Thus, despite obvious constraints to expanding wheat production in Zimbabwe, there is reason to be optimistic that wheat will continue to have a place in the farm enterprise.

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WHEAT POLICY OPTIONS IN ZIMBABWE: A COMPARATIVE ADVANTAGE APPROACH

M. L. Morris[1]

INTRODUCTION

Zimbabwe is unusual among SADCC countries in producing most of its own wheat. From 1965 to 1975, rapid growth in wheat production transformed the nation from a net wheat importer to a net exporter. Although wheat consumption has since overtaken production and revived the need for imports, domestically-produced wheat continues to make up the major part of supply.

Recent developments suggest that Zimbabwe's current high level of wheat self-sufficiency may be threatened. Demographic and economic factors have increased the demand for bread and other wheat based products more rapidly than domestic wheat production has been able to expand, forcing the government to rely on imports to make up the shortfall. Commercial imports averaged around 100,000 mt in each of the last three years and would have been even greater had the government not imposed limits. Wheat is currently rationed to millers, who claim that demand exceeds the available supply by at least 25-30%. While such figures are difficult to substantiate in the absence of reliable consumption data, the millers' claims are supported by the appearance in Harare of occasional bread lines.

The widening gap between wheat supply and demand raises important policy questions. Some analysts have argued that wheat production could be increased considerably if official producer prices were raised to provide adequate incentives for farmers (Headicar, 1987). Others have replied that wheat production is inherently unprofitable in Zimbabwe, and that the country would be better off concentrating on traditional export crops such as tobacco and cotton to generate the foreign exchange with which to purchase wheat in global markets (Muir-Leresche, 1987). The policy debate is complicated by the fact that most wheat is grown by large-scale commercial farmers. Consequently, government policies affecting wheat are likely to have different impacts on commercial and communal producer groups.

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In an era of stagnating exports, spiralling food imports, and growing uncertainty about the future political climate in Southern Africa, two central questions concern wheat policy in Zimbabwe:

- o Is it an efficient use of resources for Zimbabwe to produce wheat, now and in the foreseeable future?
- o If it is efficient to produce wheat, what combination of policy incentives and technological change are needed to promote domestic wheat production?

The objective of this paper is to provide answers to these two questions. The framework of analysis involves the calculation of resource cost ratios to determine Zimbabwe's comparative advantage among six major crops--wheat, maize, soyabeans, groundnuts, cotton, and tobacco. Crop budgets are used to assess the profitability to farmers and to the nation of each of the six crops under current and potential future production scenarios. Comparative advantage is determined by calculating the economic returns to domestic resources used in the production of each crop, measured from the point of view of the nation. Profitability calculated by this method can differ substantially from farmer profitability, because of government policy interventions. The results of the budget analysis reveal the effects of current policies on resource allocation in commercial agriculture and provide a basis for judging whether agricultural policies have created producer incentives consistent with the national interest, in the sense of maximizing efficiency.

The framework of analysis used in this paper should be of interest to analysts and policy makers not only in Zimbabwe, but also in other countries where difficult questions are being raised about how best to meet the rising demand for bread and other wheat based products. The domestic resource cost (DRC) approach provides an operational method for measuring a country's comparative advantage across crops and makes possible quantification of the cost of domestic wheat production vs. the cost of importing. Thus, comparative advantage analysis has the potential to contribute to the food security dialogue in all of the SADCC countries.

A FRAMEWORK FOR MEASURING COMPARATIVE ADVANTAGE

Comparative advantage is an expression of the efficiency of using local resources to produce a particular product when measured against the possibilities of trade. While the concept of comparative advantage frequently is used for regional analysis, it can also be used at the national level, as in the present study.

In a very simple example of comparative advantage, assume that one hectare of land and a given amount of other inputs can be used to produce either cotton or wheat. If the yield of cotton is 1 mt/ha, then at current international prices (adjusted for transportation costs) this cotton, if exported, will purchase about 10 mt of wheat. Since the same one hectare of land and the same given amount of other inputs will produce only 5 mt of wheat, the country is better off producing cotton for export and importing wheat. In this example, the country has a comparative advantage in cotton production.

Comparative advantage can be expressed quantitatively in several different ways. One of the most useful is by means of the resource cost ratio (RCR), which is a measure of the domestic resource cost to a country of producing a particular commodity. A number of excellent sources are available describing the rationale for and use of domestic resource cost analysis (Pearson and Monke, 1987; Byerlee and Longmire, 1986a; Pearson *et al.*, 1981). No attempt is made here to describe the methodology in detail, although the following explanation may be useful.

The resource cost ratio for a particular commodity or product is calculated by dividing production inputs and outputs into "tradeables" and "non--tradeables" and expressing the net value of non-tradeables as a proportion of the net value added to tradeables:

$$\text{RCR} = \frac{\text{Net value of non-tradeable domestic resources}}{\text{Net value added to tradeables}}$$

where: net value of non-tradeable domestic resources = value of non-tradeable inputs - value of non-tradeable outputs
Value added to tradeables = value of tradeable outputs - value of tradeable inputs

A RCR below one indicates that the value of the domestic resources used in production is less than the value of the foreign exchange earned or saved. Thus, a country has a comparative advantage in products associated with a RCR of less than one, since the country earns or saves foreign exchange in their production. Conversely, a RCR above one indicates that the value of domestic resources used in production is greater than the value of the foreign exchange earned or saved, and the country does not have a comparative advantage in production.

One critical aspect of the calculation of RCR's is the valuation of inputs and outputs. Market prices of inputs and outputs do not necessarily reflect true economic values in the presence of government policies such as subsidies, taxes, price restrictions, wage policies, and exchange rate controls. Consequently, before RCR's are calculated, it may be necessary to adjust market prices to eliminate the effects of policy-induced distortions. This adjustment is accomplished by assigning all inputs and outputs shadow prices (here referred to as "social prices") reflecting their true value in the economy. Social prices are determined differently for "tradeable" and "non-tradeable" items. Tradeables are valued at their world price equivalent, or the price at which they can be imported or exported, adjusted for transport costs and exchange rate anomalies. Non-tradeables are valued at their returns in the most profitable alternative use, again expressed in world price equivalents. (For more information on pricing tradeables and non-tradeables, see Pearson and Monke, 1987; and Gittinger, 1982.)

Social prices can differ substantially from market prices, such as when farmers pay less than the full import cost of fertilizer because of a government subsidy, or when they receive less than the full value of their output because the official producer price is set below the world price. When significant discrepencies exist between market and social prices, the interests of farmers and of the nation can diverge. A crop can be profitable to farmers (e.g., because of high producer prices or subsidies on inputs), even though its production does not represent an efficient use of resources from the national point of view. Conversely, a crop can be unprofitable to farmers (e.g., because of low producer prices or taxes on inputs), even though its production represents an efficient use of the nation's resources. Comparison of farmer profitability with national profitability thus provides important insights into the impacts of government policies.

CONTEXT OF THE STUDY

Wheat was introduced into present-day Zimbabwe by European missionaries in the late 19th century, but it did not become an important crop until the *Unilateral Declaration of Independence* (1965) reduced commercial grain imports and precipitated the need for self-sufficiency in basic cereals production (Ngobese, 1987). The nation's response to this challenge was little short of remarkable. In an extremely short period, a viable wheat industry was created. Historical data indicate that the steady increase in production which occurred between 1965 and 1980 resulted both from increases in area planted to wheat, as well as from a strong upward trend in yields (Table 1).

Despite the remarkable success achieved in Zimbabwe in increasing domestic wheat production, consumption of wheat has grown even more rapidly. As shown in Table 1, total wheat consumption tripled during the past two decades, and consumption per capita rose by roughly half. The forces underlying this rapid increase in wheat consumption appear similar to those found elsewhere in Sub-Saharan Africa and indeed throughout much of the

Table 1. Wheat data, 1965-1986, Zimbabwe.

Year	Harvested area (ha)	Average yield (mt/ha)	Production (000mt)	Consumption (000 mt)	Net imports (000mt)	Bread price[a] (Z$/loaf)
1965	1,619	2.35	3.8	84	80.2	b
1966	4,419	2.01	8.9	108	99.1	b
1967	5,222	2.69	14.1	99	84.9	b
1968	7,325	3.58	26.2	109	82.8	0.23
1969	12,039	3.23	39.0	114	75.1	0.23
1970	15,322	3.67	56.2	116	59.8	0.25
1971	23,688	3.71	87.7	119	31.3	0.24
1972	24,276	3.39	82.2	111	28.8	0.23
1973	22,620	3.81	86.1	130	43.9	0.23
1974	26,819	3.35	89.9	141	51.1	0.23
1975	32,569	4.00	130.2	146	15.8	0.24
1976	34,282	4.29	147.2	120	(27.2)[c]	0.23
1977	44,817	3.91	175.4	125	(50.4)[c]	0.24
1978	47,708	4.27	203.9	144	(59.9)[c]	0.24
1979	36,868	4.39	162.0	169	7.0	0.21
1980	38,461	4.97	191.2	205	13.8	0.21
1981	36,845	5.46	201.2	223	21.8	0.21
1982	37,378	5.70	213.0	234	21.0	0.21
1983	23,000	5.40	124.3	227	102.8	0.21
1984	17,000	5.79	98.5	220	121.5	0.21
1985	38,037	5.40	205.5	248	42.5	0.22
1986	43,184	5.75	248.3	270	21.7	0.23

[a]1980 prices. [b]Data not available. [c]Numbers in parentheses indicate exports.
Sources: FAO, CSO, CFU

developing world--rising incomes, increasing urbanization, changes in consumer tastes and preferences, and decreases in the price of wheat relative to substitutes (Byerlee and Sain, 1986; Byerlee and Longmire, 1986b; Byerlee, 1987).

Despite the rapid growth in demand for wheat, government has not used consumer price policy to discourage consumption. Even though the Grain Marketing Board (GMB) runs a permanent deficit on its wheat trading account, indicating continuing subsidies to millers, retail bread prices have remained constant in real terms over the past two decades (Table 1). With the demand for bread and other wheat based products exceeding supply, the government has relied instead on import controls and rationing to limit consumption.

Zimbabwe is one of the few countries in Sub-Saharan Africa that has achieved anything close to self-sufficiency in wheat production. Zimbabwe actually exported modest quantities of wheat during the late 1970s, but since then demand has outpaced supply, forcing the government to import. Wheat imports increased rapidly during 1984 and 1985 after several consecutive years of drought reduced the local harvests. Although production has since recovered to long-term trend levels, the goal of self-sufficiency remains elusive (Figure 1).

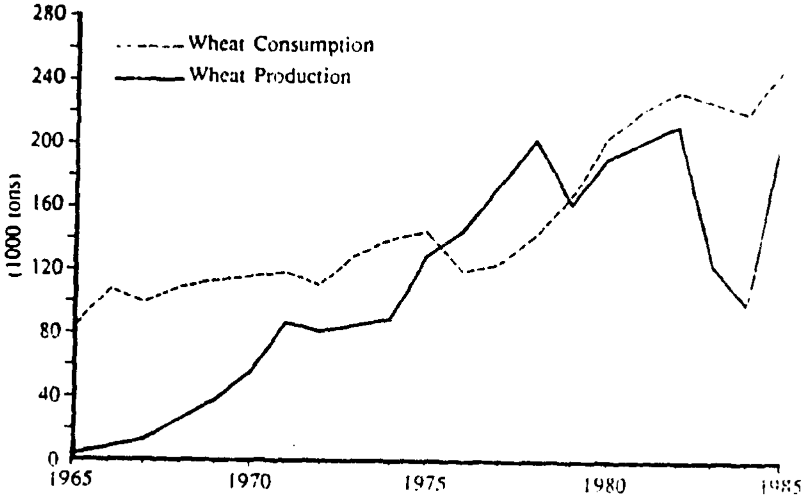

Figure 1. Production and Consumption of Wheat in Zimbabwe (1965 - 1985)

ENTERPRISE BUDGETS AND CALCULATION OF RCR'S

Sources of data for enterprise budgets

Enterprise budgets were constructed for the six major irrigated crops grown by commercial farmers in Zimbabwe (wheat, maize, soyabeans, groundnuts, cotton, and tobacco) to estimate farmer and national profitability, and to calculate resource cost ratios[2]. Budgets were also constructed for the same six crops grown under rainfed conditions, to provide a standard for comparing the economics of irrigated and rainfed agriculture. The budgets are representative of the typical commercial farm in the highveld and middleveld zones, where most of Zimbabwe's field crops are grown. (The complete enterprise budgets appear in Appendix A.)

Technical coefficients for the various crop enterprises were obtained from a number of sources. For all irrigated crops except tobacco, the primary sources of technical information were the prototypical budgets published each year by the agricultural extension service (AGRITEX) and by the Commercial Farmers Union (CFU). Tobacco data were obtained from the production files published by the Zimbabwe Tobacco Association (ZTA). Rainfed crop budgets were derived by adjusting the irrigated crop budgets to reflect differences in input use and yields.

The enterprise budgets reflect recommended levels of production technology, which closely resemble levels actually in use on commercial farms in the highveld and middleveld. The budgets assume that farmers own the machinery required for all crop operations, except combine harvesting and aerial application of selected fertilizers and pesticides, which are assumed to be contracted. Machinery costs were obtained from capital budgets estimated for tractors, tillage equipment, combine harvesters, farm dams (with pump), and irrigation equipment.

Finally, the enterprise budgets do not take into account non-enterprise related expenses sometimes included in farm budget analysis as "basic overhead expenses" (e.g., living expenses, accountant's fees, general insurance, personal taxes, etc). Since such expenses affect all enterprises equally, their exclusion from the present analysis does not affect the ranking of individual crops, although it does increase the apparent profitability of all crops.

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[2]Space limitations preclude the inclusion in the present version of the paper a complete description of the derivation of shadow prices used in the profitability analysis. For a detailed explanation of the derivation of the shadow prices used, see Morris (1988).

Farmer profitability

Farmer profitability per ha of the six irrigated crops was calculated using 1986 market prices for inputs and outputs. Results of the profitability analysis are shown in Table 2. Not surprisingly, tobacco is by far the most profitable irrigated crop from the farmer's point of view, with estimated net returns to the farmer's land, management and labour of Z$2,783/ha. Cotton is the next most profitable irrigated crop, with a net return of Z$751/ha. Wheat ranks third (Z$178/ha), followed closely by maize (Z$177/ha), groundnuts (Z$170/ha), and finally soyabeans (Z$144).

Farmer profitability per ha of the six crops grown under rainfed conditions was also calculated[3]. The farmer profitability of rainfed crops differs from that of irrigated crops in several respects. First, the absolute profitability per ha o[illegible] six crops is lower. Second, the relative profitability of the six crops [illegible]; under rainfed conditions, tobacco (Z$852/ha) remains the most profitable crop by far, still followed by cotton (Z$259/ha), but

Table 2. Estimated farmer and national profitability (Z$/ha) of six major crops under irrigated and rainfed production, 1986, Zimbabwe[a].

	Wheat	Maize	Soya-beans	Ground-nuts	Cotton	Tobacco
FARMER PROFITABILITY						
Irrigated net returns	178	177	144	170	751	2,783
Rainfed net returns	70	122	93	82	259	852
NATIONAL PROFITABILITY						
Irrigated net returns	682	679	113	684	1,550	8,703
Rainfed net returns	297	315	64	372	637	5,137

[a]Data rounded to the nearest dollar.
Source: Crop budgets

[3]The rainfed wheat budget uses Kenya data (Longmire and Lugogo, 1987), since Zimbabwe doesn't grow rainfed wheat. An average Kenyan yield of 2.5 mt/ha is assumed, comparable to DR&SS summer wheat trials (Stenhouse, 1987).

maize now ranks third (Z$122/ha), followed by soyabeans (Z$93/ha), groundnuts (Z$82/ha), and finally wheat (Z$70/ha).

National profitability

Next, the irrigated and rainfed enterprise budgets were recalculated, using social prices to assess the relative profitability of the six crops from the national point of view. As indicated previously, social prices are prices which have been corrected for policy distortions. In the initial national profitability calculations, no opportunity cost values are assigned to land and water. Subsequently, the analysis is extended by costing these two critical production inputs.

The social price of a product differs, depending on whether the product is imported or exported. If the product is imported (as in the case of wheat), transportation and handling costs must be added to the world reference price to arrive at a social price based on the import parity price. But if the product is exported (as in the case of cotton and tobacco), transportation and handling costs must be subtracted from the world reference price to arrive at a social price based on the export parity price. In this study, only wheat is considered an imported commodity. All others are considered export commodities (or potential export commodities).

National profitability was first calculated for the six crops grown under irrigation. In comparison with the results obtained using market prices, two features of the recalculated net returns are noteworthy (Table 2). First, the use of social prices drastically increases the profitability per ha of five out of the six irrigated crops, with only soyabeans suffering an absolute decline. Second, the relative profitability of the various irrigated crops changes very little. Tobacco (Z$8,703/ha) and cotton (Z$1,550/ha) are still the two most profitable irrigated crops, followed at some distance by groundnuts (Z$684/ha), wheat (Z$682/ha), and maize (Z$679/ha). In terms of national profitability, soyabeans (Z$113/ha) continue to lag well behind the other irrigated crops.

National profitability was next calculated for the six crops grown under rainfed conditions. As before, the use of social prices drastically increases the profitability of five out of the six rainfed crops, with only soyabeans suffering an absolute decline. From the point of view of the nation, tobacco (Z$5,137/ha) and cotton (Z$637/ha) remain the two most profitable rainfed crops, but groundnuts (Z$372/ha) now climbs to third, and maize (Z$315/ha) supplants wheat (Z$297/ha) as the most profitable grain crop. Once again, soyabeans (Z$64/ha) rank as the least profitable crop.

Comparing farmer and national profitability

The differences between farmer profitability and national profitability for each crop grown under irrigation are shown in Table 3. These differences represent the net effect per hectare of government policies. A positive difference implies that government policies on the whole favor production of a particular crop (by making production more profitable to the farmer than it is to the nation), while a negative difference implies that government policies on the whole discriminate against the production of a particular crop (by making production less profitable to the farmer than it is to the nation). The results appearing in Table 3 indicate that the net policy effect is negative for five out of the six crops grown under irrigation. Only soyabeans are favored by government policies; all of the others are discouraged.

Table 3 disaggregates the net policy effect for each crop to reveal the effects of specific government policies:

- Producer price policy generally reduces the profitability of agriculture, in that farmers receive less than the world price equivalent (based on current world prices) for five out of the six crops. The only exception is soyabeans; soyabeans producers receive a price higher than the world price equivalent (export parity price).

Table 3. Sources of differences between farmer and national profitability (Z$/ha) of irrigated crops, Zimbabwe.[a]

Crop	Farmer profit-ability	National profit-ability	Net policy effect	Differences due to policies on: Product price	Machi-nery	Purch-ased inputs	Labour	Credit	All other[c]
Wheat	178	682	(504)	(329)	(46)	(78)	(39)	24	(36)
Maize	177	679	(502)	(336)	(43)	(48)	(89)	20	(6)
Soyabeans	144	113	30	145	(26)	(42)	(27)	15	(35)
Groundnuts	170	684	(515)	(305)	(44)	(47)	(138)	25	(6)
Cotton	751	1,550	(799)	(486)	(42)	(57)	(219)	29	(25)
Tobacco	2,783	8,703	(5,919)	(6,053)	(66)	(60)	(619)	87	791[b]

[a]Data rounded to the nearest dollar. [b]Includes effect of processing losses incurred between the auction floor and export. Farmers receive payment for the 15% of the crop that is not used (stems and veins). [c]All other policies includes energy, transport, and insurance.
Source: Crop budgets

- Policies affecting farm machinery prices also generally reduce the profitability of agriculture by making farmers pay more to purchase and maintain their machinery than they would in the absence of these policies. However, the inflationary effects of import surtax tariffs and sales taxes on farm machinery are partially offset by the over-valued exchange rate, which reduces the prices of farm machinery in terms of local currency.
- Policies affecting the prices of purchased inputs (seed, fertilizer, crop chemicals) also generally reduce the profitability of agriculture by raising market prices above world equivalent prices. The greatest effect is on nitrogen fertilizer, since continued reliance on high cost domestic manufacturing capacity results in significantly higher costs relative to world nitrogen prices.
- Labour policy, specifically minimum wage legislation, reduces the profitability of commercial agriculture by increasing the cost of farm labour. This effect is most pronounced in the case of crops requiring a high labour input (e.g., tobacco, cotton, groundnuts).
- Agricultural credit policy, specifically, the provision of AFC credit at rates several points lower than the rates offered by commercial banks, increases the profitability of agricultural production by reducing the cost of short-term credit.

Assessing the economic value of land and water

In the preceding analysis, no opportunity cost values were assigned to land or water. The underlying assumptions concerning land are that it is wholly owned by the farmer (hence no mortgage or rental costs are included in the farmer profitability analysis), and that it is not a limiting resource (hence no opportunity costs for land are included in the national profitability analysis).

Similarly, the underlying assumption concerning water is that water is not a limiting resource (hence the only water-related costs included in the profitability analysis are the costs of building a dam, installing an irrigation system, and pumping water onto the crop--costs incurred in procuring water, but conceptually distinct from the value of the water itself).

Although it is possible to envision scenarios in Zimbabwe in which neither land nor water has an opportunity cost, typically farmers must decide how to allocate limited amounts of land and/or water between several alternative cropping enterprises. In such cases, land and/or water has an opportunity cost: in choosing to allocate land and water to a particular crop, the farmer must forego the revenue which might have been generated by allocating the same resources to an alternative crop. Consequently, domestic resource cost analysis is more meaningful when land and water are valued at their opportunity cost.

Determining the opportunity cost value of land

In theory, the opportunity cost value of land planted to a particular crop is simply the net returns to the land in its most profitable alternative use. In practice, application of this concept is complicated by the fact that there are many different land types with different sets of alternative uses and hence, different opportunity cost values.

Since the analysis presented in this paper pertains specifically to "typical" highveld and middleveld wheat farms, three simplifying assumptions can be made concerning alternative uses of agricultural land:

- o Irrigated wheat is the only commercially viable winter crop. While some winter barley is grown under contract to the breweries, the market for barley is limited, and the feed value of barley is too low to warrant its production. Therefore, during winter the next most economic alternative to growing wheat is to leave land idle, and the opportunity cost of land in wheat production is zero.
- o Tobacco, irrigated or rainfed, is by far the most profitable crop, so any land suitable for tobacco production will be used for that purpose. Therefore, the opportunity cost value of land in irrigated tobacco production is considered to be its potential value to the nation in rainfed tobacco production, or Z$5,137/ha.
- o Cotton, soyabeans, groundnuts, and maize are all summer crops which can be grown on the same land under either irrigated or rainfed regimes. Therefore, the opportunity cost value of land in irrigated soyabean, groundnut, and maize production is considered to be its potential value to the nation in cotton production, or Z$1,550/ha, and the opportunity cost of land in cotton production is considered to be its potential value to the nation in the next most profitable use, groundnuts production, or Z$684/ha.

Determining the opportunity cost value of water

As in the case of land, the theoretical opportunity cost value of irrigation water is the net returns to the water in its most profitable alternative use. However, in practice net returns to irrigation water depend on many factors, particularly the application method and its timing in the biological growth cycle of the crop. Consequently, precise calculation of the net returns to irrigation water would require detailed knowledge of the response functions relating the amount and timing of water applied to crop yield. At present, such response functions are not available, although research is underway on this important topic (MacRobert and Mutemeri, 1987).

This study uses a simple method to estimate the opportunity cost value of irrigation water applied to the six major commercial crops. The difference in net profitability between growing each crop under irrigated and rainfed regimes is attributed to the effect of the irrigation water. Dividing the increase in net profitability by the amount of water applied gives a measure of incremental net returns per unit of water applied, or the average value of water. (For the sake of simplicity, evaporation losses incurred in storing water from the rainy season into the dry season are ignored.) Depending on whether farmer profitability figures or national profitability figures are used, the result represents either the "farmer value" of water or the "national value" of water applied to each crop.

The values for irrigation water obtained using this method are shown in Table 4. Not surprisingly, one unit of water applied to tobacco is associated with a greater increase in farmer net returns than one unit of water applied to any other crop. Water applied to cotton is associated with the next greatest increase in farmer net returns, followed by water applied to maize, soyabeans, groundnuts, and wheat. These results are consistent with observed practice. In times of drought, farmers in Zimbabwe first allocate limited water supplies to the two high value crops, tobacco and cotton. Water is applied to grains (maize and wheat) and/or oilseeds (groundnuts and soyabeans) only when the irrigation requirements of tobacco and cotton have been satisfied (Pilditch, 1987).

Table 4. Average value (net returns) of irrigation water by crop, 1986, Zimbabwe[a].

Crop	Amount of irrigation	Farmer benefits[b]:				National benefits[b]:			
		Irrigated	Dryland	Value of irrigation[c]		Irrigated	Dryland	Value of irrigation[c]	
	mm	(Z$/ha)		(Z$/ha)	(Z$/mm)	(Z$/ha)		(Z$/ha)	(Z$/mm)
Wheat	720	178	70	108	0.15	682	297	385	0.53
Maize	240	177	122	55	0.23	678	315	363	1.51
Soyabeans	240	144	93	51	0.21	113	64	49	0.20
Groundnuts	528	170	82	87	0.17	684	372	312	0.59
Cotton	624	751	259	492	0.79	1,550	637	913	1.46
Tobacco	380	2,783	852	1,932	5.08	8,703	5,137	3,565	9.38

[a]Data rounded to nearest dollar. [b]Net returns [c]Difference due to irrigation.
Source: Crop budgets

The national values of irrigation water shown in Table 4 differ somewhat from the farmer values. Although water is still associated with the greatest increases in net returns when applied to tobacco, from the point of view of the nation, water has approximately equal value when applied to maize or cotton. Wheat and groundnuts represent the next most profitable uses of water, followed at some distance by soyabeans.

Calculating resource cost ratios

Resource cost ratios for each irrigated crop were calculated to provide quantitative measures of comparative advantage. Inputs and outputs were classified as tradeable or non-tradeable. Tradeable items were valued at their world price equivalent (social price). These included all outputs, as well as farm machinery depreciation, fuels and oils, and imported purchased inputs (fertilizers, crop chemicals). In addition, 75% of farm machinery repairs and maintenance costs, 50% of transport costs, and 50% of machinery hire charges were also classified as tradeable items and were valued at their world price equivalent (social price).

Non-tradeable items were valued at their actual market price, except for capital, labour, land, and water. Non-tradeable items valued at market prices included lime and gypsum, packing materials, drying costs, insurance, crop levies, electricity, interest payments, 25% of farm machinery repairs and maintenance costs, 50% of transport costs, and 50% of machinery hire charges. A real cost of capital of 10% was assumed, reflecting what is thought to be the opportunity cost of capital in Zimbabwe, net of taxes.

Land and water were assigned several opportunity cost values, depending on whether land or water was assumed to be the limiting factor in production. In the land-limiting case, the value assigned to land represents the residual returns to land in the best competing alternative use valued at world price equivalent, and the value assigned to water is simply the procurement cost (storage and pumping). In the water limiting case, no opportunity cost value is assigned to land, but the value assigned to water represents the procurement cost plus the average value of the water in the best competing alternative use valued at world price equivalent.

Land limiting case

Table 5 shows the resource cost ratios for the six irrigated crops when land is the limiting factor of production. In the land-limiting case, three irrigated crops--wheat, tobacco,and cotton--have resource cost ratios below one, indicating that Zimbabwe enjoys a comparative advantage in their production. The resource cost ratio of 0.44 associated with wheat signifies that Z$0.44 worth of domestic resources used in wheat production generates Z$1.00 of (net) foreign exchange earnings. This extremely low resource cost ratio is largely explained by the fact that land used for irrigated wheat production in the highveld and middleveld has no economically viable alternative use in winter and therefore carries an opportunity cost value of zero.

Water limiting case

Table 5 also shows the resource cost ratios for the six irrigated crops when water is the limiting factor of production. In the water-limiting case, only one irrigated crop--tobacco--has a resource cost ratio below one, reflecting a comparative advantage in production. All of the other resource cost ratios are driven above one in the water-limiting case by the high opportunity cost value assigned to water used in tobacco production. During times of drought, clearly the most efficient use of water from the point of view of the nation is to irrigate tobacco.

Land and water limiting case

The land-limiting and water-limiting cases examined above are overly simplistic. Most commercial farmers typically operate under a combination of land and water constraints. For example, they may have enough water to irrigate only part of their farm, and at the same time variability in land types and soil conditions may preclude free substitution among crops. Often in such instances, the critical question facing farmers is the following: assuming there is enough water available to irrigate the entire tobacco crop, what crop(s) should next be irrigated? Table 5 also shows the resource cost ratios for the six irrigated crops when land and water are both limiting factors of production. In this case, the opportunity cost values assigned to water are initially the same as in the water-limiting case, and the most profitable course of action is to irrigate tobacco. However, assuming that not all land is suitable for tobacco production, eventually land becomes a limiting

Table 5. Resource cost ratios of irrigated crops, 1986, Zimbabwe.

Limiting factor	Wheat	Maize	Soya-beans	Ground-nuts	Cotton	Tobacco
Land	0.44	1.86	4.84	1.99	0.66	0.66
Water	6.13	2.54	6.70	5.16	3.08	0.25
Land & water	1.35	0.70	1.69	1.28	0.78	0.25

Source: Calculated from crop budgets.

factor as well. If water is left over after all available "tobacco soils" have been planted to tobacco, the opportunity cost value of the remaining water is no longer its value in tobacco production, since the land constraint precludes planting more tobacco. Once all available "tobacco soils" have been planted to tobacco, the opportunity cost value for water reverts its value in the most profitable remaining possible use, maize production (except in the case of maize production itself, where the most profitable alternative use is cotton production).

As can be seen in Table 5, when this lower opportunity cost value for water is used, the resource cost ratios associated with maize (0.70) and cotton (0.78) both drop below one. These results indicate that in times of drought, once the tobacco crop has been taken care of, Zimbabwe has a comparative advantage in maize and cotton production. The resource cost ratio associated with wheat remains above one (1.35), indicating that wheat production does not represent an efficient use of domestic resources when water supplies are limited, even after the tobacco crop has been irrigated.

POLICY IMPLICATIONS

Effects of current policies

One important implication revealed by the analysis presented above is that existing agricultural policies provide incentives for commercial farmers to plant those crops in which Zimbabwe currently has a comparative advantage. The budgets calculated for irrigated wheat, maize, soyabeans, groundnuts, cotton, and tobacco confirm what many farmers already know: although all six of the crops generate positive net returns, it is most profitable to concentrate first on tobacco and second on cotton. The resource cost ratios calculated using national prices reveal that what is good for farmers frequently is also good for the nation: Zimbabwe enjoys a comparative advantage in these two crops, at least during years when water is plentiful. However, the resource cost ratios indicate that if water availability is limited by drought, once tobacco irrigation needs have been satisfied there is a slight advantage to the nation in using the remaining water to apply supplementary irrigation to maize.

If DRC analysis fails to reveal any major policy-induced distortions between crops, several interesting policy effects become evident through the use of social prices.

First, producer price policy in Zimbabwe discriminates against five out of the six crops examined in this study, in the sense that producers receive less for their crops than the world price equivalent. (Recall that the world price equivalent is based on the import parity price in the case of wheat, and on export parity prices in the cases of the other five crops.) Only soyabeans prices are higher than what they would be in the absence of price controls. Thus, producer price policy on the whole taxes commercial agriculture.

Second, a number of government policies affect the prices paid by farmers for their machinery and purchased inputs. Taxes (e.g., import surtax tariffs and sales taxes) exert upward pressure on production costs, but this effect is partially offset by exchange rate policy, since the overvaluation of the Zimbabwe dollar effectively reduces the domestic price of imported machinery and inputs.

Third, labour policies have a differential impact across crops. During the last five years, minimum wage legislation has succeeded in raising the incomes of agricultural workers employed in the formal wage sector. However, higher incomes have been achieved at the cost of fewer jobs. Minimum wage legislation has raised the cost of agricultural labour, inducing employers to substitute capital for labour by hiring fewer workers and purchasing additional machinery to perform a wider range of crop operations. In cases where mechanization is infeasible (e.g., harvesting tobacco and cotton), production costs are driven up.

Fourth, wheat can be a profitable crop for farmers in Zimbabwe, although it is probably true that many wheat growers are forced to accept smaller margins on wheat than they earn on some of the summer crops. Significantly, as long as irrigation water is readily available, wheat is also profitable from the national point of view. But in times of drought, when farmers must choose between irrigating wheat and irrigating other crops, it is more profitable from the points of view both of farmers and of the nation to use water on tobacco, maize, and cotton.

Effects of possible future developments

Technological change

At present, two factors discourage rainfed wheat production in Zimbabwe. First, improved germplasm is lacking: most available summer wheat varieties are heat intolerant, low yielding, and highly susceptible to diseases, especially rust. Second, economics dictates against rainfed wheat production: rainfed wheat must compete for land with other more profitable summer crops. However, these two barriers might be overcome. DR&SS breeders are presently working on developing improved germplasm with higher yield potential and enhanced disease resistance in the warmer summer temperatures. While average yield levels are still modest (in the range of 2-2.5 t/ha), breeders remain optimistic that that significant progress is possible over the medium to long term, particularly in high altitude regions (Stenhouse, 1987).

If and when improved germplasm becomes available, the second constraint might take care of itself. Sensitivity analysis of the rainfed-wheat budget allows calculation of the likely farmer profitability of summer wheat production under a range of assumed yields. Table 6 shows the estimated returns to land and management of rainfed wheat production under different yield levels, compared to the estimated returns to land and management of competing rainfed crops. At a yield of 2t/ha, summer wheat production would still be unprofitable. At a yield of 2.5 t/ha, the farmer could expect to earn positive net returns of Z$70/ha, but these would be too low to make summer wheat competitive with other rainfed crops. At a yield of 3 t/ha, wheat might begin to enter into the rotation, since the estimated net returns of Z$214/ha would make wheat more profitable than maize from the farmers' point of view.

Changes in input and output prices

How are future changes in world prices likely to affect Zimbabwe's current pattern of comparative advantage? The profitability of the six irrigated crops was recalculated using projected future prices for outputs and fertilizers. Table 7 shows net returns to land and management at current (1986) prices compared to net returns at projected (year 2000) prices, which were estimated by adjusting current prices upward or downward by the percentage changes forecast by World Bank commodity price analysts (World Bank, 1985). When the projected year 2000 prices are substituted for current prices in the budgets, the estimated profitability of the the six crops shows little change. Tobacco (Z$9,187/ha) remains the most profitable crop by far, followed by cotton (Z$4,658/ha), with wheat (Z$976), groundnuts (Z$817), and maize (Z$736) once again bunched some distance behind. Again, soyabeans (Z$190) trails all other crops.

These figures suggest that future developments in global commodities markets probably will not eliminate Zimbabwe's current comparative advantage in tobacco and cotton production. While this conclusion must be tempered by the knowledge that past forecasts of world commodity prices have often been inaccurate, the fact that tobacco is nearly 10 times as profitable as the highest-ranking grain, and cotton nearly five times as profitable, suggests that relative prices would have to change a great deal in order for these two traditional export crops to be displaced.

Restrictions on agricultural trade

Political developments in South Africa, to the extent that they have economic consequences, could affect Zimbabwe's current structure of comparative advantage, with important implications for food policy. In particular, further

Table 6. Profitability of rainfed wheat (Z$/ha) at four yield levels, compared to the profitability of four competing rainfed crops[a].

Rainfed crops	Net returns to land and management at:	
	Market prices	Social prices
Rainfed wheat at:		
1.5 t/ha yield	(218) [b]	(47) [b]
2.0 t/ha yield	(74) [b]	125
2.5 t/ha yield	70	297
3.0 t/ha yield	214	469
Maize	122	315
Soyabeans	93	64
Groundnuts	82	372
Cotton	259	637
Tobacco	852	5137

[a]Data rounded to the nearest dollar. [b]Negative net returns.
Source: Crop budgets

Table 7. Profitability (Z$/ha) of irrigated crops at projected prices compared to current prices, Zimbabwe[a].

Irrigated crops	National net returns of land and management at:	
	1986 prices [b]	Year 2000 prices [b]
Wheat	682	976
Maize	679	736
Soyabeans	113	190
Groundnuts	684	817
Cotton	1550	4658
Tobacco	8703	9187

[a]Data rounded to the nearest dollar. [b]Assumes water is not a limiting factor of production.
Source: Crop budgets

restrictions on trade with and transit through South Africa would have considerable effects on the agricultural sector by affecting the availability and prices of production inputs, the prices received for agricultural exports, and the prices paid for food imports.

It is difficult to model the effects of such a scenario with any degree of quantitative precision, since it is impossible to predict what form trade restrictions might take. Nevertheless, the effects of a restricted trade scenario can be anticipated in qualitative terms. In general, production costs for all crops would increase because imported inputs would become more expensive. At the same time, the value of export commodities would decline due to the increased cost of getting them to market, while the value of import-competing commodities would rise due to the increased cost of procuring supplies from outside the country.

These qualitative conclusions concerning the likely effects of trade restrictions are borne out by sensitivity analysis of the irrigated crop budgets. Table 8 shows the estimated national profitabilities of the six irrigated crops under a "restricted trade" scenario. One likely impact of trade restrictions has been modelled by increasing port-to-border rail freight rates for all crops, as well as for imported fertilizers, by a factor of three. As expected, the profitability of wheat increases relative to that of the other crops.

Table 8. Estimated national profitability of irrigated crops under a "restricted-trade" scenario, Zimbabwe.

Irrigated	National net returns (Z$/ha) to crop land and management under:	
	Free trade	Restricted trade[a]
Wheat	682	1375
Maize	679	35
Soyabeans	113	(260) [b]
Groundnuts	684	395
Cotton	1550	964
Tobacco	8703	8200

[a]Railage and handling charges to port increased. [b]Indicates negative net returns.
Source: Crop budgets

Thus, trade restrictions would have important implications for wheat policy. Since the national value of wheat would rise as a function of rising import costs, it would probably make economic sense for Zimbabwe to strive for higher levels of self-sufficiency in wheat, presumably through some combination of production enhancement and consumption management policies. If the trade restrictions also affect other SADCC countries, it is likely that Zimbabwe would additionally be able to export wheat to some of its neighbours.

CONCLUSION

Agricultural policy makers in Zimbabwe today face the difficult question of what to do about the widening gap between supply and demand of wheat. Even though Zimbabwe's wheat industry is well developed by regional standards, the fact that domestic production has not been able to keep pace with demand has necessitated wheat imports, creating a drain on scarce foreign exchange and heightening concerns about the erosion of national food security. The question of whether or not wheat production should be expanded thus assumes critical importance in the food policy debate.

This paper has presented preliminary results from a study undertaken to establish whether or not Zimbabwe enjoys a comparative advantage in wheat production and to assess the effects of government policies on producer incentives. Comparative advantage was measured by calculating resource cost ratios for six major commercial crops under several land-limiting and water-limiting scenarios to determine which crops represent the most efficient use of domestic resources.

The results presented above suggest that agricultural policies in Zimbabwe provide incentives for commercial farmers to allocate scarce resources to those crops which are most profitable from the national point of view (tobacco and cotton, in most instances). The results also reveal how government policies affect the economics of farming, sometimes positively (as in the case of subsidized agricultural credit programs), but more usually negatively (as in the case of controlled producer prices, taxes on inputs, and wage policies).

One important finding is that wheat production represents an efficient use of Zimbabwe's resources in periods when water is plentiful. This implies that the government should be careful to set wheat producer prices at least high enough to enable farmers to recover variable costs, thereby ensuring continued production during the winter season. However, another finding is that during times of drought both farmers and the nation as a whole are better off if water is used to irrigate tobacco, then cotton and maize. This implies that the government might consider relaxing its current policy of requiring NFIF loan farmers to grow wheat during the winter months, if this means they will not have enough water to irrigate tobacco.

Sensitivity analysis was used to test the robustness of the results under several possible future scenarios. Use of projected year 2000 prices for outputs and major inputs did not significantly alter the comparative advantage rankings, indicating that future developments in world commodity markets are unlikely to warrant drastic changes in Zimbabwe's internal agricultural policies. However, use of high rail freight costs for imports and exports to simulate the likely effects of trade restrictions increased the profitability of wheat production relative to that of other crops, indicating that a shift in production patterns would be appropriate should access to a deep water port become restricted.

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Appendix A1. Irrigated crop budgets, 1986 market prices, Zimbabwe[a]

Crop	Wheat	Maize	Soya	G'nuts	Cotton	Tob-acco
Assumed Yield	5.50	7.50	3.00	3.50	3.25	3.00
GROSS RETURNS	1650	1350	1020	1628	2438	7500
FIXED COSTS						
Irrigation Costs:						
Dam and pump	86	29	29	63	74	45
Irrigation equip.	86	29	29	63	74	45
Farm Machinery Costs (depreciation):						
Tractor	68	98	51	77	63	122
Tillage equip.	9	13	7	10	8	16
Tobacco Barns & Sheds	0	0	0	0	0	163
VARIABLE COSTS						
Machinery Operating Costs						
Tractor: Fuel & Oil	50	73	37	57	47	123
R & M[b]	68	98	51	77	63	200
Tillage equip:R & M[b]	1	1	1	1	1	0
Purchased Inputs:						
Seed & treatment	72	36	72	111	16	5
Fertilizer & lime	400	275	166	174	231	391
Herbicides	14	47	73	111	58	478
Pesticides	5	13	10	22	168	0
Fungicides	0	0	0	185	0	0
Packing materials	11	9	3	9	8	38
Irrigation Costs:						
Electricity	245	82	82	180	212	129
R & M[b]	21	7	7	16	19	11
Contract Hire Services:						
Aerial application:						
Pesticides	0	0	0	0	136	55
Fertilizer	0	14	0	0	0	0
Combine harvesting	89	0	89	0	0	0
Transport	47	78	31	63	39	355
Other Costs:						
Fertilizer						
Transport/handling	21	15	10	17	13	0
Crop insurance	6	8	4	7	10	364
Drying	3	0	3	0	0	479
Levy	8	9	15	24	34	167
Labour Costs:						
Skilled labour	7	10	5	8	6	12
Unskilled labour	78	178	53	276	438	1237
Interest on working capital (6 months)	80	66	49	93	104	281
TOTAL FIXED COSTS	248	168	115	213	220	391
TOTAL VARIABLE COSTS	1224	1005	761	1245	1467	4325
TOTAL COSTS	1472	1173	876	1458	1686	4717
NET RETURNS TO MANAGEMENT AND LAND	178	177	144	170	751	2783

[a]Data rounded to the nearest Z$. [b]Repairs and maintenance.

Appendix A2. Irrigated crop budgets, 1986 social prices, Zimbabwe[a]

	Wheat	Maize	Soya	G'nuts	Cotton	Tob-acco
Assumed Yield	5.50	7.50	3.00	3.50	3.25	3.00
GROSS RETURNS	1979	1686	875	1933	2923	12428
FIXED COSTS						
Irrigation Costs:						
Dam and pump	75	25	25	55	65	39
Irrigation-equip.	75	25	25	55	65	39
Farm Machinery Costs: (depreciation)						
Tractor	57	82	43	65	53	102
Tillage equip.	6	8	4	7	5	11
Tobacco Barns & Sheds	0	0	0	0	0	163
VARIABLE COSTS						
Machinery Operating Costs:						
Tractor: Fuel & oil	43	62	32	49	40	113
R & M[b]	54	78	41	61	50	161
Tillage equip. R & M[b]	1	1	1	1	1	0
Purchased Inputs:						
Seed & treatment	72	36	72	111	16	5
Fertilizer & lime	308	222	115	126	170	266
Herbicides	13	46	71	109	56	526
Pesticides	5	13	10	22	164	0
Fungicides	0	0	0	181	0	0
Packing materials	11	9	3	9	8	38
Irrigation Costs:						
Electricity	245	82	82	180	212	129
R & M[b]	16	5	5	12	14	8
Contract Hire Services:						
Aerial application:						
Pesticides	0	0	0	0	136	55
Fertilizer	0	14	0	0	0	0
Combine harvesting	75	0	75	0	0	0
Transport	61	101	40	82	51	390
Other Costs: Fertilizer						
Transport/handling	27	20	13	22	17	0
Crop insurance	7	10	4	8	12	364
Drying	3	0	3	0	0	240
Levy	10	12	13	29	41	167
Labour Costs:						
Skilled labour	7	10	5	8	6	12
Unskilled labour	39	89	27	138	219	619
Interest on working capital (6 months)	90	73	55	103	109	278
TOTAL FIXED COSTS	212	141	97	181	188	355
VARIABLE COSTS	1085	867	664	1067	1185	3371
TOTAL COSTS	1297	1008	762	1248	1373	3725
NET RETURNS TO MANAGEMENT & LAND	682	679	113	684	1,550	8703

[a]Data rounded to the nearest Z$. [b]Repair and maintenance.

Appendix A3. Rainfed crop budgets, 1986 market prices, Zimbabwe[a].

	Summer Wheat[b]	Maize	Soya	G'nuts	Cotton	Tob-acco
Assumed Yield	2.50	4.50	2.00	2.00	1.50	2.00
GROSS RETURNS	750	810	680	930	1125	5000
FIXED COSTS						
Farm Machinery Costs: (depreciation)						
Tractor	68	80	51	77	63	122
Tillage Equip.	9	11	7	10	8	16
Tobacco Barns & Sheds	0	0	0	0	0	163
VARIABLE COSTS						
Machinery Operating Costs:						
Tractor:						
Fuel & oil	50	59	38	57	46	123
R & M[c]	68	80	51	77	63	200
Tillage equip. R & M[c]	1	1	1	1	1	0
Purchased Inputs:						
Seed & treatment	72	36	72	111	16	5
Fertilizer & lime	200	138	83	87	116	195
Herbicides	14	47	73	111	58	478
Pesticides	5	13	10	22	168	0
Fungicides	0	0	0	185	0	0
Packing materials	11	9	3	9	4	38
Contract Hire Services:						
Aerial application:						
Pesticides	0	0	0	0	136	55
Fertilizer	0	14	0	0	0	0
Combine harvesting	89	0	39	0	0	0
Transport	21	47	21	36	18	355
Other Costs:						
Fertilizer Transport/handling	10	8	5	8	6	0
Crop insurance	3	5	3	4	5	364
Drying	1	0	2	0	0	167
Levy	4	6	10	14	16	167
Labour Costs:						
Skilled labour	7	8	5	8	6	12
Unskilled labour	9	103	30	153	211	1091
Interest on working Capital (6 months)	39	40	34	61	60	285
TOTAL FIXED COSTS	77	91	58	87	72	301
TOTAL VARIABLE COSTS	603	597	529	760	794	3847
TOTAL COSTS	680	688	587	848	866	4148
NET RETURNS TO MANAGEMENT & LAND	70	122	93	82	259	852

[a]Data rounded to the nearest Z$. [b]Estimated based on data from Kenya. [c]Repairs and maintenance.

Appendix A4. Rainfed crop budgets, 1986 social prices, Zimbabwe[a]

	Summer wheat[b]	Maize	Soya	G'nuts	Cotton	Tob-acco
Assumed Yield	2.50	4.00	2.00	2.00	1.50	2.00
GROSS RETURNS	900	899	583	1105	1349	8285
FIXED COSTS						
Farm Machinery Costs (depreciation):						
Tractor	57	67	43	65	53	102
Tillage equip.	6	7	4	7	5	11
Tobacco Barns & Sheds:	0	0	0	0	0	163
VARIABLE COSTS						
Machinery Operating Costs:						
Tractor:						
Fuel & oil	43	50	32	49	40	113
R & M[c]	54	63	41	61	50	161
Tillage equip. R & M[c]	1	1	1	1	1	0
Purchased Inputs:						
Seed & treatment	72	36	72	111	16	5
Fertilizer & lime	161	115	63	68	90	142
Herbicides	13	46	70	109	56	526
Pesticides	5	13	10	22	164	0
Fungicides	0	0	0	181	0	0
Packing materials	11	9	3	9	4	38
Contract Hire Services:						
Aerial application:						
Pesticides	0	0	0	0	136	55
Fertilizer	0	14	0	0	0	0
Combine harvesting	75	0	75	0	0	0
Transport	28	54	27	47	24	293
Other Costs:						
Fertilizer Transport/handling	14	10	6	11	8	0
Crop insurance	3	5	2	4	5	364
Drying	1	0	2	0	0	240
Levy	5	6	9	17	19	167
Labour Costs:						
Skilled labour	7	8	5	8	6	12
Unskilled labour	5	51	15	77	105	546
Interest on working Capital (6 months)	45	43	39	69	65	213
TOTAL FIXED COSTS	63	74	47	71	58	276
TOTAL VARIABLE COSTS	540	510	471	661	654	2873
TOTAL COSTS	602	584	519	732	712	3148
NET RETURNS TO MANAGEMENT & LAND	297	315	64	372	637	5137

[a]Data rounded to the nearest Z$. [b]Estimated based on data from Kenya. [c]Repairs and maintenance

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GRAIN TRADE, BARTER, AND TRIANGULAR TRADE : PROPOSED RESEARCH AND POLICY ISSUES WITH SPECIFIC REFERENCE TO ZIMBABWE'S EXPERIENCE

T. Takavarasha[1]

INTRODUCTION

The concepts of border prices and comparative advantage provide a useful analytical format for assessing the feasibility of triangular transactions; and their impact in promoting grain trade, on foreign exchange savings, food security, and facilitating the adoption of appropriate grain production and consumption policies in the region.

It is important to recognize that the principle of comparative advantage is only one criterion for deciding on the feasibility of alternative agricultural policies. Government frequently has other (unquantifiable) resource allocation objectives besides efficiency, such as food security and income distribution.

This paper first reviews Zimbabwe's experience in dealing with triangular transactions in grain trade. Second, it examines major issues in maize production, export, and stockholding policy. Finally, it looks at the domestic wheat industry. In this section, research areas which are relevant for promoting grain production and regional trade are identified.

It is hoped that the tentative observations highlighted in this paper will stimulate further analysis of the important issues in pricing policy, import substitution, grain stock management, export promotion, and comparative advantage relevant to the production of agricultural products to achieve food security.

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THE CONCEPT OF TRIANGULAR TRANSACTIONS IN GRAIN TRADE

The deficit food supply situation in several SADCC member states has provided a stimulus for initiating triangular transactions, primarily involving wheat and maize.

Food supply situation in the SADCC region (SADCC, 1987)

SADCC member states are highly dependent on agricultural exports to earn foreign exchange. In 1984, five member states earned more than 40% of all export earnings from agricultural commodity sales. Trade within the SADCC region is extremely small because of product similarity, the low level of industrialization, marketing and transport constraints, and the inconvertibility of currencies.

From 1970 to 1974, the annual per capita growth rate of food production in the SADCC region fell to -1.2% due to drought, destabilization, and other factors. Consequently, during this period cereal imports to the region grew at an annual growth rate of 6.9% reaching 2.09 million mt in 1984-85. Food aid to the region doubled over the period 1980-81 to 1986-87, to about one million mt per annum.

In this paper, food aid is defined as a transfer of food resources from a donor country to a recipient country which is both experiencing structural food deficits (or food emergencies) and a shortage of foreign exchange to import food commercially (World Food Programme).

Zimbabwe's experience with triangular transactions

Zimbabwe's experience with triangular transactions and periodic food surpluses dates back to 1980-81 when the World Food Programme first initiated the concept as a means to dispense food aid to neighbouring states and to help Zimbabwe dispose of surplus maize stocks. (Latif, 1986).

In the five-year period from 1981-82 to 1985-86, Zimbabwe imported a total of 293,000 mt of wheat comprised of 63,000 mt (22%) of direct food aid, 30,000 mt (10%) of direct commercial imports, and 153,400 mt of wheat in exchange for 72,000 mt of maize for distribution to neighbouring states (Takavarasha, 1986).

Triangular transactions usually involve three or four parties: a donor/cooperating partner which provides cash to purchase food or directs food from its own resources as aid; an agent such as the WFP to handle the food aid; a country supplying the food; and the recipient country.

A triangular transaction becomes a swap/barter deal if, instead of providing cash to purchase food, a cooperating partner makes available a commodity which is in short supply in the food donor country in exchange for a commodity required in the food aid recipient country. Zimbabwe has received part of its wheat through this form of trade, in exchange for maize from its surplus stocks.

Advantages and disadvantages of triangular transactions

In the absence of lucrative commercial markets for a surplus product (e.g., maize), swap deals can benefit a supplying country by reducing storage problems, interest charges, handling costs, and possible wastages. In addition, it may save foreign exchange where the triangular transaction supplies a commodity (e.g., wheat) that would otherwise have to be imported into the supplying country using scarce hard currency. This further helps the supplying country to sustain its agricultural pricing and investment policies through increased sales of surplus commodities.

However, the production of regionally tradable commodities entails foreign exchange expenditures in convertible currencies since these expenditures are required to import farm inputs. Thus, grain surplus producers selling stocks to recover costs usually prefer to receive at least part of their payments in convertible foreign exchange so they can finance imports necessary for further agricultural development.

To the recipient, a major benefit is that triangular transactions involve food bought from a neighbouring country. This invariably results in speedy delivery, provides the country with food of similar quality to which it is accustomed, and helps to promote regional trade.

However, a problem arises when production cycles are not synchronized in the region, such that food surpluses and deficits coexist within neighbouring countries[2].

Thus, the major problems associated with triangular transactions include the inability to find willing partners, (especially where the potential donor is also experiencing food surpluses), boom-bust grain production pattern in the region, problems in calculating appropriate costs and commodity exchange ratios, handling constraints, and high production costs in supplying countries in relation to world prices. This aspect is dealt with in the next subsection.

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[2]The primary objective of the SADCC Regional Early Warning System for Food Security Project is to provide advance information on food crop production and food supplies in the SADCC region, so member states can take action in response to impending food shortages or surpluses.

Calculation of commodity exchange rates for triangular transactions

The administrative procedures followed in determining triangular transactions are as follows: the Grain Marketing Board (GMB)--in consultation with the Ministry of Lands, Agriculture and Rural Resettlement--determines the quantity of maize that is available for external disposal and the projected wheat shortfall to be imported; and then identifies willing bilateral or multilateral partners to supply wheat in exchange for maize to a recipient country.

After determining the appropriate exchange rates, the deal is submitted to the Special Trading Arrangements Committee, chaired by the Ministry of Trade and Commerce, for approval. The Reserve Bank is particularly interested in assessing the impact of a deal on foreign exchange earnings and on balance of payments.

There are several ways to calculate an exchange rate for commodity swops. One method is illustrated below:

- o Assume that a cooperating partner wishes to purchase 20,000 mt of maize from Zimbabwe and donate it to a nearby state. Instead of paying Zimbabwe in cash, it offers an equivalent amount of wheat. The freight on board (F.O.B.) Harare maize price is negotiated on the basis of ruling world prices or prevailing prices in the most recent regional commercial export transactions. In most cases, this price has been below Zimbabwe's break-even price of Z$222 per mt (1985-86).
- o Using that price, the next step is to determine how much Zimbabwe would have been paid in cash, if it had sold the maize commercially. For example: 20,000 mt times Z$165 equals Z$3.3 million. Thus, to lend 1 mt of wheat would cost Z$187. It follows that Z$3.3 million of maize revenue would buy (Z$3.3 million divided by Z$187) 17,600 mt of wheat. This gives a commodity exchange ratio of 1:1.14 (i.e., 1 mt of wheat costs 1.14 mt of maize).

Clearly, the commodity exchange ratio and the foreign exchange implications will depend on the negotiated prices, bridging costs, and source/destination of the commodities in question. A high exchange ratio means that more maize is paying for less wheat, and vice versa.

Table 1 shows the maize:wheat exchange ratio for selected maize-wheat deals concluded since 1981-82. During the period, the ratio has varied by 100%, ranging from 1:0.8 to 1:1.61.

As shown in Table 2, the ratio of the local selling prices of wheat and maize has varied much less than the maize:wheat exchange ratio obtained through recent swaps.

Table 3 shows economic prices for maize and wheat, calculated on the basis of average costs and quoted commodity prices for the period February to September, 1987.

Table 1. Wheat:maize exchange ratios, 1981-82 to 1987-33, Zimbabwe.

Year	Maize (mt)	Wheat (mt)	Wheat:maize Exchange Ratio
1981-82	21,450	16,500	1:1.30
1982-83	42,500	26,500	1:1.60
1982-83	4,903	4,903	1:1.00
1982-84	31,000	19,224	1:1.61
1984-85	31,600	23,704	1:1.29
1985-86	9,000	7,333	1:1.23
1986-87	2,700	3,372	1:1.80
1987-88	23,467	20,767	1:1.13
1987-88	39,899	36,272	1:1.10
1987-88	11,110	10,100	1:1.10

Source: Grain Marketing Board.

Table 2. Local selling prices of wheat and maize, 1981-82 to 1987-88, Zimbabwe

Year	Maize (Z$/mt)	Wheat (Z$/mt)	Wheat:maize price ratio
1981-82	137	157	1.15
1982-83	137	169	1.23
1982-84	137	169	1.23
1984-85	157	239	1.52
1985-86	177	285	1.61
1986-87	222	323	1.45
1987-88	222	358	1.61

Source: Ministry of Lands, Agriculture and Rural Resettlement.

Table 3. **Calculation of economic prices for wheat and maize, 1987, Zimbabwe**

Price Components	Unit	Wheat	Maize
FOB/CIF, U.S. Gulf			
Price in Zimbabwe dollars[a]	Z$/mt[b]	187.38	114.95
Freight, insurance, and port charges	Z$/mt	+ 61.67	(61.67)
Railage costs to/from Harare	Z$/mt	+ 74.15	(74.15)
FOB/CIF price Zimbabwe	Z$/mt	323.20	-20.87

[a]US prices are $114.30 (wheat) and $70.12 (yellow maize). A premium for white maize can be added to that figure.
[b]Z$1.00 = US$0.61.

Proposed research

There is a need to evaluate triangular transactions to determine their impact on net foreign exchange earnings, local trading accounts of maize and wheat, the development of regional grain trade; as well as to provide a sound basis for determining commodity exchange ratios for triangular transactions.

Such analysis would also make a significant contribution to the proposed SADCC Regional Food Reserve and Regional Food Aid Project, whose main priority will be to support food needs in member states, arising from natural calamities and a shortage of foreign exchange to purchase foodstocks.

The wider implications of triangular transactions on regional trade, agricultural production policy, and grain stock management and procurement policies in individual countries also needs to be assessed. This is the subject of the next two sections which focus on analyzing some major elements of production policy in Zimbabwe.

MAIZE PRODUCTION, EXPORT AND STOCKHOLDING POLICY

Maize production policy

Maize is the most important staple food in Zimbabwe. More people are engaged in its production than in any other single crop. Thus, maize production policy seeks to achieve self-sufficiency. Price policy attempts to strike a careful balance between the aims of the farming community and the ability of consumers, both locally and overseas, to bear the consequent increases in the consumer prices. Further, price policy decisions take into account the viability of the industry, stock levels, impact on parastatal operating costs, and food security considerations.

A major characteristic of maize production is the variations in yields, primarily due to drought and other climatic cycles.

The following statistics for the large-scale commercial sector indicate the magnitude of the yield variation. In the communal sector, yields are even more variable since most communal farms are located in the lower rainfall and more drought-prone regions (Table 4).

Drought-induced, cyclical downswings in maize yields often result in dramatic increases in food insufficiency and rapid depletion of household and national stocks.

Maize export and stockholding policy

The GMB, established by an Act of Parliament in 1931, is mandated to fulfill a food security function, which involves holding large grain stocks as one of its major functions (See Makone, 1986; and Muchero, 1986; for more details on the functions of the GMB).

Table 4. Estimated average seasonal yields for maize in the large-scale commercial sector, 1980-81 to 1985-86, Zimbabwe.

Season	Yield (mt/ha)
1980-1981	2.96
1981-1982	4.28
1982-1983	2.58
1983-1984	3.23
1984-1985	5.49
1985-1986	4.65 (estimate)

Source: Ministry of Lands, Agriculture and Rural Resettlement.

Maize is by far the most important commodity handled by the GMB, accounting for 80% of the quantity of controlled products purchased locally in 1985-86.

The significant year-to-year fluctuations in the quantities of maize purchases and sales to consumers presents a major problem in stock management and export disposal. Table 5 shows the extreme variation in production and consumption which results from these seasonal fluctuations. Notwithstanding a peak grain stock position of 1.2 million mt in 1982, Table 5 shows that stocks on 31 March 1984 (marketing year end) stood at only 122,692 mt, requiring the government to import 269,000 mt at an approximate cost of more than Z$50 million.

When the GMB-based marketing system was conceived, communal farmers were predominantly subsistence producers. Relatively little marketed surplus was delivered to the board by this sector. In recent years, this state of affairs has changed dramatically, culminating in 1985-86 with some 45% of total maize deliveries originating from the peasant sector.

The complexity of the board's operations increased substantially as the number of producers registered with the board increased dramatically from under 30,600 in 1980 to almost 400,000 at the end of 1986. A vast majority of the newly registered producers are small farmers, most of whom deliver extremely small quantities at a time, which increases the workload.

Table 5. Maize stocks, intake and disposal, (000 mt), 1979-1987, Zimbabwe.

Year	Stocks[a]	Intake	Exports (imports)	Local consumption
1979-80	65	512	265 (149)	635
1980-81	158	815	86 (95)	724
1981-82	1,201	2,014	305	665
1982-83	1,035	1,391	492	1,042
1983-84	123	617	252	1,273
1984-85	462	942	(269)	860
1985-86	1,426	1,828	285	561

[a]Stocks held on 31 March.
Source : Grain Marketing Board.

Analysis of purchases from communal producers in the 1986-87 season indicates that more than 75% of the sellers delivered under 5 mt but they accounted for only 35% of the total quantity delivered from communal areas.

Another related factor is that over the past 20 years, local maize sales have increased at an average annual rate of about 8.6%, a rate that considerably exceeds the rate of population increase (Food Studies Group, 1987). There are strong indications that local maize sales are inversely related to intake, probably reflecting the reduced role of on-farm retentions and increased dependence on the market for supplies, in place of subsistence production. This trend becomes more pronounced during poor agricultural years.

Definition of surplus stock

There is growing concern that reference to "surplus", simply on the basis of stocks held by the GMB, is a misleading approach for determining future production policy and the size of externally disposable surplus (SADCC, 1987). This is "because this (measure) rests on the assumption that what farmers deliver to the GMB, for example, is what remains after they have stored adequate (on-farm) supplies to meet their own anticipated consumption requirements, and that their cash income will not be used to acquire grains on the market". In other words, it is becoming quite evident that actual national surpluses may be a lot less than indicated by the size of centralized stockpiles--when viewed in the context of marked fluctuations in production/intake levels and the increasing dependence of producers on the market to satisfy consumption requirements.

The above assumption is particularly problematic in the case of small-scale farmers who appear to be holding lower on-farm stocks and selling to the GMB an increasing percentage of their output in the immediate post-harvest period; and in turn, paying less attention to household level grain storage and repurchasing that same output at a later time at a higher cost.

Furthermore, this trend does not necessarily signify that each and every household in the producing areas is satisfying its nutritional requirements. It is possible that surpluses only exist at the national (global) level.

Two conclusions can be drawn from the above observations. First, the GMB might be receiving more than merely the surplus after on-farm requirements of small-scale farmers have been satisfied. Second, the rising national stock levels do not necessarily indicate rising net availability of grain for export.

Consequently, it is recommended that instead of continuing with the programme to establish more high capacity storage facilities--which often result in high overhead costs--attention should be given to constructing a relatively more decentralized system of lower capacity grain storage facilities at the village and district level, and which are not necessarily owned by the board.

These will not only serve as bulking-up points for onward shipping to main consumption areas, but also grain stores for eventual local redistribution in times of poor harvests and as rural food-processing centres.

Proposed research

This situation suggests at least three closely related areas for research which would contribute to our understanding of food security and regional grain trade.

Comparative advantage in maize production at both the regional and household levels[3]

Promoting maize production does not necessarily imply that each household must be self-sufficient in maize production. Rather, every household should have access to sufficient food, either from own production or by using income derived from nonfood crops and nonagricultural activities to purchase food.

Determining optimum stockholding policy for the GMB and promoting alternative decentralized grain storage facilities[4]

It is believed that the low marketing margins offered to rural grain traders operating under controlled prices and government's clearly stated preference

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[3]The D.Phil research proposal by T. Takavarasha (author) involves the application and interpretation of domestic resource cost calculations for major agricultural commodities produced in Zimbabwe, to agricultural policy analysis--particularly pricing policy, production, and export policy. A. O'Driscoll, technical adviser in the Economics and Markets Branch of the Ministry is currently undertaking related research to determine the ratio of foreign currency gain to domestic costs incurred in the production of major agricultural products.

[4]Due to excessive fluctuations in maize intake and demand, government feels it should maintain stocks at an 18 months' normal consumption level, equal to the approximate demand in a drought year--approximately 1 million mt of maize. Maintaining such a stock level at 1985-86 producer prices and board costs would require an investment of Z$222 million. At a rate of 10% per year, interest would be Z$22.2 million per annum and the 1% shrinkage and out-turn loss would add an additional Z$2.22 million per annum; giving a total of Z$24.42 million.

for uniform panterritorial pricing, severely limits nongovernmental investments in rural grain trading and storage. Child, Muir and Blackie (1984) in their paper, An *Improved Marketing System for Zimbabwe* advocated an alternative approach, involving free trade within floor-ceiling prices.

> This paper proposes that single channel marketing be replaced by an internal free market operating between floor and ceiling prices; these prices being maintained by GMB supply manipulation to prevent excessive producer and consumer welfare fluctuations. [Available evidence].... suggests that such a system would be more efficient and would have beneficial effects on Zimbabwean development. The system is more equitable for the rural sector. It could be expected to produce greater stability of producer incomes, more reliable food supplies, higher producer prices, and release public funds currently used for consumer subsidies and for infrastructural development.

A related research area is the role of credit for promoting on-farm or village level grain storage (Muchero, 1986). Apart from saving current unnecessary costs of excessive transportation and capital intensive central warehousing, storage credit would help small farmers to meet seasonal cash requirements without having to dispose of their food retentions.

THE DOMESTIC WHEAT INDUSTRY IN ZIMBABWE

This section highlights some of the major issues that might affect the future development ot the wheat industry in Zimbabwe, and have an impact on grain trade (Longmire, Ngobese and Tembo, 1986).

Wheat production and consumption trends

In Zimbabwe, wheat is produced as an irrigated crop in the winter. Although research into the production of summer wheat is underway, summer wheat will only supplement, not replace, winter wheat production.

Zimbabwe, like many developing countries, is experiencing a very rapid growth in the demand for wheat and wheat products. This is generally attributed to changes in tastes away from traditional course grains, rising per capita incomes, and urbanization. The rise in demand reflects the preferences of urban consumers for bread as a "convenience" food, which eliminates time and fuel in food preparation. This trend also applies to rural consumers.

What is particularly disturbing to policy makers is that wheat products, particularly bread, are slowly becoming basic food staples which many people feel they cannot do without. Furthermore, this is happening at a time when production costs are increasing and foreign exchange resources are declining.

Low bread prices--relative to local food staples--consumer subsidies, and the tendency to import wheat at overvalued exchange rates are other factors which contribute to increasing wheat consumption.

For the past three years, the Grain Marketing Board's off-take of wheat has been restricted to about 20,000 mt per month or 240,000 mt annually (plus additional 10,000 mt during festive periods). If sufficient wheat were available, it is estimated that the demand could easily exceed 300,000 mt per annum. Using an estimated population figure of 8.2 million, per capita consumption is therefore between 30-36 kg per year. On that basis, about 432,000 mt--more than double current production--would be required by the year 2000 to feed the projected population of 12 million.

Between 1980 and 1986, total annual domestic intake fell short of annual off-take by an average of 25% (Table 6). Imports increased from 2,654 mt in 1980-81 to 86,248 mt in 1985-86, making up an average of 22% of local sales during that period.

Table 6. Wheat purchases and sales (000 mt) 1980-81 to 1985-86, Zimbabwe.

Year	Intake	Imports	Total	Local sales
1980-81	163.0	2.6	165.6	205.4
1981-82	200.9	16.5	217.4	223.0
1982-83	212.9	31.4	244.3	233.8
1983-84	124.3	54.8	179.1	227.4
1984-85	98.5	104.2	202.7	220.0
1985-86	205.5	86.2	291.7	247.6

[a]The production year for wheat matches the calender year, since winter wheat is planted in May-June and harvested in October-November.

Wheat policy options for Zimbabwe

From the national point of view, the choice for future expansion of the wheat industry lies between two options: devoting agricultural resources to promoting export crops which generate the highest net gain in foreign exchange, so as to supplement domestic food production by imports, or increasing domestic wheat production through import substitution, using irrigation in the case of wheat, to achieve food security[5].

Policies to develop the domestic wheat industry should consider comparative advantage, given the high cost of irrigation--compared to the relatively low price of dryland wheat which is influenced by overvalued currencies in importing countries and subsidies in exporting countries (Byerlee, 1985).

Another consideration is the general desire to maintain low bread prices to consumer, given the general low level of real incomes. But in the long-run, this conflicts with the food security objective. Food security can only be sustained by allowing consumer prices for wheat products to rise to levels that reflect the true cost of imported wheat or the high cost of domestic production.

As far as individual producers are concerned, their wheat production decisions are influenced by the producer price of wheat, the prices of crop and livestock products which compete for the resources used in wheat production, the prices of agricultural inputs, and the cost and availability of capital, labour, and water resources used in wheat production.

Wheat production requires farmers to make capital outlays to develop the necessary irrigation infrastructure. With production costs rising, the producer price for wheat would have to be very high to stimulate an increase in irrigation with its high capital commitment.

Apart from the obvious need to have adequate wheat available for bread, local production of wheat encourages the storage of water which, in turn, can help to reduce the effects of drought on summer crops and enhance food security.

However, reduced water storage resulting from fluctuations in rainfall has a detrimental affect on wheat production and increases farm overhead costs.

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[5]Food Security refers to sustainable access to food resources, at both the national and household level; through local production, improved incomes, and capacity to import. Food self-sufficiency refers to sustained ability to produce total requirements of a given commodity from domestic resources. In landlocked countries with limited foreign exchange earnings priority, is often given to food self-sufficiency.

This factor might contribute to reducing the rate of expansion in wheat hectarage, unless there is adequate risk cover in the form of higher returns and cheaper capital (e.g., National Farm Irrigation Fund).

Proposed research

To guide the future development of the domestic wheat industry, research is needed to:

- develop an objective basis for calculating the economic cost and foreign exchange implications of imported wheat, compared to locally produced wheat;
- determine the optimum scale of irrigation capacity under different agroecological conditions, taking into account the impact of rainfall fluctuations on production variability;
- analyze the returns to alternative uses of irrigation resources under large-scale and small-scale production systems; and
- identify ways to increase the use of small grains in wheat based products and evaluate their impact on maize and wheat production and consumption

CONCLUSION

To adequately address grain trade issues and the impact of triangular transactions on regional grain trade, it is necessary to take into account the underlying domestic production and consumption patterns for grain crops.

The paper has set the framework for carrying out detailed analysis of intra country comparative advantages to evaluate different agricultural activities, and identify the need to correctly assess their foreign exchange implications.

The sharp agroecological disparities that exist in Zimbabwe, together with the threat of environmental degradation, suggest that if food security is to be enhanced, domestic agricultural policy should increasingly encourage those agricultural activities which are compatible with the local production potential--as determined by climatic and agroecological conditions, access to inputs and markets, food consumption patterns, and potential for alternative employment opportunities.

At the same time, agricultural policies cannot be based irrevocably on the hypothesis that surpluses and low prices on the world market will prevail. This suggests the need to build up short term stockpiles of major food commodities, given the inability to secure adequate foreign exchange reserves to import food, especially in times of drought-induced deficits.

The interaction between household food security and national stock management should be closely examined, given its impact on food production and consumption patterns, and its implications on regional grain trade.

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AGRICULTURAL MARKETING AND TRADE POLICIES TO PROMOTE FOOD SECURITY IN THE SADCC REGION: A RESEARCH PROPOSAL

K. Mlambo, D. Kingsbury, and J. Rusike[1]

INTRODUCTION

In recent years, the nine member states of SADCC have voiced great interest in expanding intraregional trade as one strategy to increasing food security within the region. The fact that six of the nine countries are landlocked, transport costs are high, and dependence on trade with external countries (including South Africa) is viewed as precarious, has contributed to a sense of urgency which resulted in the funding of prefeasibility and feasibility studies to investigate establishing a regional food security scheme based on local grain reserves.

Historically, levels of intraregional trade have been quite low. The proportion of intra-SADCC trade in overall trade for SADCC nations is only 4-5% (Michelsen, 1986). In 1982, the value of this trade was US$295.7 million. Food and live animal trade (SITC section 0) accounted for approximately 23% of intra-SADCC trade (only US$66.7 million). In grain trade, concessional food aid shipments have increased in importance over the years for a number of SADCC countries as economic conditions have worsened, civil strife has grown, and droughts have periodically occurred.

Within the region, there is considerable variability in aid receipts. In Mozambique, dependence on food aid has recently grown to crisis proportions. Over the 1979-81 period, food aid as a percentage of total cereal availability was roughly 16% and commercial imports constituted 30% of total availability (FAO, 1986, p. 39). For 1987-88, the FAO estimates total cereal import requirements at 750,000 mt while local production is forecast at only 350,000 mt (FAO, 1987, p. 42). This situation is exacerbated by the fact that Mozambique has almost no capacity to import on a commercial basis. On the other hand, in Zimbabwe and Malawi the combination of attractive

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producer prices and good weather have led to the build-up of maize stocks[2]. Recently, heavy storage costs and export sales at prices below marketing board acquisition costs have created a substantial financial burden. This coexistence of stocks and deficits within the region has resulted in an increased interest in the use of trilateral food aid transactions to simultaneously reduce the financial burden of stockholding countries and to supply imports to food deficit nations.

Currently, the dominant actors in SADCC grain trade are the grain marketing boards of the individual countries, related governmental institutions (primarily ministries of agriculture and finance), the various bilateral and multilateral development agencies that finance food aid flows, and private firms which engage in agricultural commodity and input trade.

RESEARCH OBJECTIVES

This proposal describes research to identify agricultural marketing and trade policies which have the potential to significantly influence the availability of basic staple foods for groups most vulnerable to both transitory and chronic food shortages. It is anticipated that this will contribute to identifying marketing and trade policy strategies which have the potential to improve food security in the countries of the SADCC region.

The general objectives of the research project are to:

- o describe current and historical patterns of agricultural trade within the SADCC region; between SADCC countries and South Africa; and between SADCC countries and the rest of the world, with particular emphasis on maize, wheat, and inputs such as fertilizers, seed, and agricultural machinery;
- o determine the extent to which an economic basis for trade exists within the SADCC region, given current prices and transportation costs;
- o evaluate alternative domestic agricultural and macroeconomic policies which impact on trade and food security;
- o identify constraints to expanding trade in commodities relevant to food security (both intraregionally and internationally), focusing on transactions costs and risk; and
- o analyse the potential for a number of policies and programmes to ex-

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[2]Malawi is currently in a maize deficit position and has requested food aid assistance from the international community for 1987-88.

pand trade in agricultural commodities, thereby improving food security in the SADCC region.

APPROACH

The central assumption guiding this research is that increases in intra-regional trade among the SADCC countries, if managed correctly, can benefit all parties and enhance food security. To address the general question of how to improve food security through regional trade and marketing, this question is best broken into components and dealt with at both the regional and country level.

Regional analysis

Due to resource constraints, it is impossible to examine food security issues in depth in all nine SADCC countries. Instead, the following general issues will be addressed at the regional level to provide a context for the country level analysis: historical trade patterns in agricultural commodities and inputs; the evolution of food aid dependency; historical patterns of production and consumption of major food crops and projected trends; the types of exchange rate regimes currently in place; the foreign exchange position of SADCC countries; and the effects of these on agricultural performance.

The regional analysis will be implemented by reviewing previously published studies and consultant reports. In addition, descriptive and statistical analysis will be undertaken related to production, consumption, trade, food aid, and exchange rates[3].

Country level analysis

Criteria for country selection

Detailed analysis will focus on three of the nine SADCC countries--Zimbabwe, Zambia, and Botswana. These countries were chosen for several reasons.

First, each of these countries is in a different position with regards to agricultural trade. Zimbabwe traditionally exports maize after good seasons and many experts feel that Zambia has the agroclimatic potential to eventually export grain to other nations in the region, although it has usually imported. No other SADCC country except Tanzania is judged to have much potential for significant grain exports in the near future. Botswana, on the other hand, is a persistent net importer of cereals. The country has been plagued with severe drought for the last six years.

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[3]See Appendix 1 for a detailed set of questions to be addressed at the SADCC/Southern Africa level.

Second, the countries are interesting to compare with regard to production. Zimbabwe and Zambia are among the nations which dominate Southern African agricultural production in terms of volume of production and consumption (Table 1). Over the 1984-86 period, Zimbabwe and Zambia accounted for 26.7 and 11.2% of total SADCC staple cereal production, respectively. Although Tanzanian production accounted for 35% of SADCC production, Tanzania has traditionally been considered more a part of the East African, rather than the Southern African market[4]. Malawi is another important food producer. It should also be noted that South African agricultural production dwarfs that of any single SADCC country. In contrast, Botswana has contributed the least to SADCC cereal production with an aggregate average volume of only about 13,000 mt.

Third, these three countries dominate what little intraregional trade that exists in the region. Table 2 identifies 1982 source and destination values of exports and imports of food and live animals. Zimbabwe and Botswana lead in food exports (Botswana's exports of US$7.6 million consist primarily of cattle) while Zambia leads in imports.

Finally, the three countries have had very different experiences with macroeconomic policy reform. From October 1985 to May 1987, Zambia instituted a comprehensive structural adjustment programme which included a foreign exchange auction system. The auction contributed to large devaluations of the kwacha, but greater availability of capital and consumer goods in domestic markets. Agricultural marketings and exports also grew substantially.

Zimbabwe has largely resisted liberalisation while at the same time pursuing some potentially beneficial programmes for coping with its severe foreign exchange shortage, including an export incentive scheme and revolving funds for industry, mining, and agriculture.

While the foreign exchange constraint is very serious for both Zambia and Zimbabwe, Botswana is in the unique situation of having a surplus of foreign exchange reserves due to their large diamond deposits. This, plus the fact that Botswana is a member of the South African Customs Union (SACU), means that Botswana's barriers to expanded trade are quite different than those facing the other two countries. Therefore, study of Botswana should yield some interesting comparative insights.

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[4]However, for the first time in many years, Tanzania has an exportable surplus of maize from its bumper 1986-87 season. This is in contrast to poor 1986-87 harvests for Zimbabwe, Zambia, and Malawi. As such, there may be new possibilities for trade.

Table 1. Staple Cereal Production in Southern Africa, 1984-85 averages 1'000 mt.

Commodity	Botswana	Swaziland	Lesotho	Angola	Mozambique	Zambia	Malawi	Zimbabwe	Tanzania	SADCC	S.Africa
Maize	1.1	107.6	86.1	246.7	340.0	1069.7	1375.8	2263.0	2080.7	7570.6	6709.3
Sorghum	9.5	1.9	40.7	0.0	183.3	26.4	149.7	106.5	629.0	1146.9	503.3
Rice paddy	0.0	2.9	0.0	21.3	56.7	10.6	37.9	0.4	495.1	624.7	3.0
Millet	1.2	0.0	0.0	50.0	5.0	14.8	0.0	161.7	280.1	512.7	15.0
Wheat	1.0	1.3	15.5	10.0	5.3	22.4	1.1	187.2	76.3	320.3	2015.3
Total	12.8	113.6	142.3	328.0	590.3	1143.9	1564.5	2718.7	3561.2	10175.2	9245.0
Percent SADCC	0.1	1.1	1.4	3.2	5.8	11.2	15.4	26.7	35.0	100.0	47.6[a]

Source: FAO Production Tapes and authors calculations
[a] Percent of total Southern African production

Table 2. Intra-SADCC trade in food and live animals, 1982.

Exports from:[a]	Value (mill. US$)	Imports to:	Value (mill. US$)
Zimbabwe	51.5	Zambia	19.8
Botswana	7.6	Mozambique	16.1
Malawi	5.2	Botswana	14.8
Angola	1.1	Tanzania	7.5
Tanzania	0.6	Zimbabwe	4.5
Mozambique	0.5	Angola	3.3
Swaziland	0.1	Malawi	0.4
Zambia	0.1	Swaziland	0.3
TOTAL	66.7	TOTAL	66.7

Source: Adapted from Chr. Michelsen Institute (1986).
[a]Data from Lesotho unavailable.

The relevance of grains and agricultural inputs to food security

As a first step in the focus country analysis, national household budget survey data will be examined to determine which food commodities make up major portions of rural and urban household expenditures; and which of these are most important for poor households. Similarly, on the agricultural input side, farm management data from national agencies, farming systems research projects, and other available sources will be reviewed to assess the relative importance of various purchased inputs as a percent of cash expenditures for both large scale commercial and smallholder farmers. This will provide a context for assessing the significance of staple grains such as maize, wheat, and sorghum; and inputs such as fertilizer, seed and machinery.

The role of grains and inputs in trade will then be determined. Analysis will examine the approximate ratio of foreign currency to domestic currency contained in inputs, the extent to which foreign exchange is recovered through commodity exports, and incentives and disincentives created by agricultural policy and macroeconomic factors such as foreign exchange management and exchange rate policies.

Economic basis for trade

The key question which then needs to be answered is whether an economic basis for trade in agricultural commodities and inputs exists which could contribute to food security. Recent analysis of secondary data indicates conflicting evidence as to the existence of a basis for intraregional trade. Koester (1986) compares composition and variability of agricultural production and trade and concludes that expanded trade based on comparative advantage is possible. Stackhouse's review (1987) of the literature and analysis of trade statistics suggests that there may be a basis for trade in agricultural commodities, but there is little solid evidence that significantly expanded trade makes economic sense or is feasible--given existing production and consumption patterns, economic policies, and transport constraints. Further analysis is needed at both the intraregional and international trade levels.

One can assess the economic basis for trade by comparing import parity prices with actual market prices. For example, if the export price of Zimbabwean white maize plus transportation costs (the import parity price) to Lusaka is higher than the actual Lusaka market price, one could then hypothesize that trade potential exists which was not realized, due to prohibitively high transactions costs[5].

One can also examine whether domestic market prices fluctuate more

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[5]Transactions costs include costs which arise from immobile or "specific" assets, limited information about the general economic environment, and the need to safeguard against opportunistic behaviour by other market participants (Williamson, 1981). These costs are not purely financial and are often hard to quantify. However, by observing the difference between the actual Lusaka price and the import parity price cited as an example above, it is possible to identify an approximate lower monetary limit.

In the Southern African context, transactions costs commonly include costs arising from submitting documents required by government, complicated payments methods, and the need to convert local currencies into convertible currencies.

widely than international prices, both seasonally and between years[6]. If this is the case, a potential may exist to even out price swings through trade and food aid, thus contributing to food security. This opportunity is conditional on imported commodities being released onto the market at appropriate times and in quantities which guarantee that prices will not fall precipitously, thus damaging local production and storage incentives.

There is anecdotal evidence that unrecorded trade between some of the SADCC states is quite substantial. Certainly the full story does not emerge from officially published statistics. Incentives for cross border parallel trade created by uncoordinated official pricing and exchange rate policies will be assessed, at least for maize and fertilizer.

Institutional analysis of market behaviour and performance

In most cases, applied trade research has focused exclusively on relative resource endowment and pricing issues. To understand existing trade patterns in Southern Africa and realistically assess the possibilities of expanded trade, one must also closely examine other important functions which facilitate the matching of supply and demand in agricultural markets. Major coordinating functions for agricultural commodity and input subsectors are shown in Figures 1 and 2. As can be seen, "getting prices right" is only one factor which sends signals to market participants. Inadequate coordinating mechanisms may lead to prohibitively high transactions costs which in turn stifle trade.

To examine these issues more closely, a survey of private firms engaged in agricultural commodity and input trade will be carried out in the three focus countries. These data will be analysed to assess traders' perceptions about which coordinating mechanisms need to be altered to improve performance. Analysis will also be focused on potential activities which donor agencies could support to alleviate some of the problems arising from ineffective coordinating mechanisms.

Because parastatal marketing boards dominate agricultural marketing activity at the national level, the researchers will also analyze their role in sending market signals. As well as examining price incentives, the study will

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[6]In highly regulated agricultural markets where prices are controlled (such as in Zimbabwe and Zambia) and do not fluctuate greatly, it is more appropriate to look at changes in subsidy outlays aimed at maintaining a given price or a set of floor and ceiling prices.

Figure 1. Role of coordination in matching supply and demand for a community sub-sector.

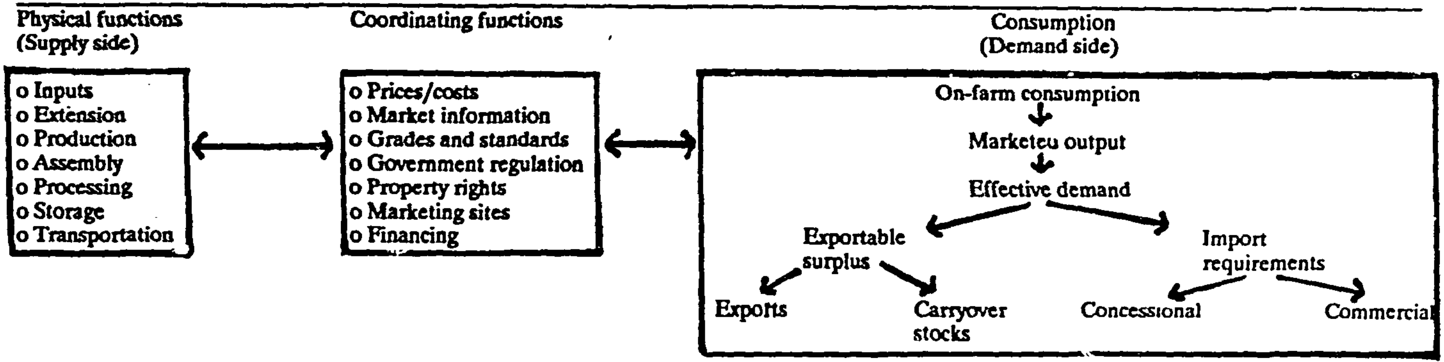
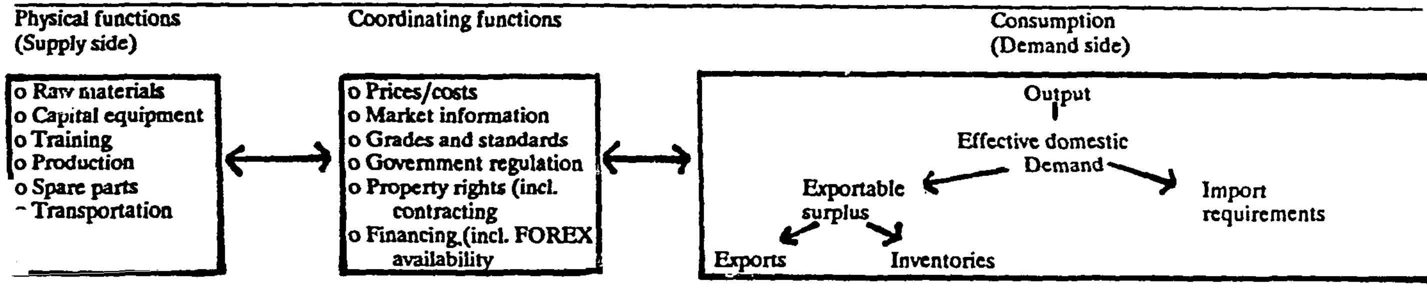


Figure 2. Role of coordination in matching supply and demand for an input subsector



Source: Adapted from Mighell, R.L. and L.A. Jones 1963 also focus on how parastatals interact with private traders and their governments[7].

The pricing and institutional analysis discussed above will be incorporated into two case studies. One will address the question of whether potential exists for expanded intraregional trade in agricultural inputs. Several input manufacturing industries with export potential will be identified in the three focus countries. This effort will combine analysis of potential supply and demand, manufacturing profitability, and information from the trader surveys to determine what potential exists and what mechanisms need to be in place to expand trade.

The second case study will examine Zimbabwean and Zambian foreign exchange management policies. This study will examine the following questions. How was foreign exchange allocated before, during, and after the Zambian experiment with the auction system; and what was its impact on the agricultural sector? Concerning Zimbabwe, how well has the Export Incentive Scheme and the various revolving funds functioned? What particular benefits has agriculture enjoyed as a result of these programmes? Pertaining to both countries, what has been the priority given to agriculture, relative to other sectors in foreign exchange allocation? Has the sector been taxed or subsidized when one considers foreign exchange earnings generated by the sector? Do these countries provide lessons that are relevant for other SADCC nations?

TENTATIVE RESEARCH OUTPUTS

During the course of the research, working papers will be prepared and disseminated periodically, following the procedure established in previous work carried out under the UZ/MSU Food Security Project. These will serve as a basis for meaningful dialogue between the researcher, experts on Southern African trade, decision makers involved in agricultural trade policy, and private firms. The five general topics to be covered are:

o An Overview of Agricultural Trade, Production, and Consumption in Southern Africa. Analysis will focus on trade, food aid, and production and consumption patterns to determine the extent of historical intraregional trade; and to identify areas where a potential for expanded

[7]See the last two pages of Appendix I for a detailed list of some of the questions to be addressed in the trader surveys and study of the parastatals.

trade may exists. The authors will also briefly review research which has attempted to address the basis for trade issue in Southern Africa.

- Price Analysis of the Potential for Food Security-Enhancing Trade for Three SADCC Nations. The researchers will assess the importance of staple grains and various purchased inputs to food security. This will involve reviewing household expenditure surveys and production cost data from the three focus countries. In addition, parity prices will be calculated, the extent of policy harmonization across countries will be determined, and comparisons of international and domestic price variability will be made.
- Case Study of the Potential for Expanded Intraregional Trade in Agricultural Inputs. The working paper will report on analysis of one or two input subsectors where there is a potential for expanding intra-regional trade. The research will combine price and institutional analysis to assess this potential.
- Case Study of the Zimbabwean and Zambian Experience With Foreign Exchange Management. Analysis will focus on the effects on the agricultural sector of the Zambian experience with foreign exchange auctioning. For Zimbabwe, the authors will examine foreign exchange management policy as well as the impacts of various export promotion programmes on agricultural performance.
- Trader Assessments of Barriers to Trade: Zimbabwe, Zambia, and Botswana. An effort will be made to identify the risks private firms face and how they attempt to avoid or reduce these risks to tolerable levels. Analysis will centre on the coordinating mechanisms discussed earlier. In addition, the research will examine the key variables which distinguish firms that have developed effective coping strategies from those which are having trouble coping.

The final report will include a summary of material presented in working papers and further analysis of preliminary results. In addition, it will consider marketing and trade policies and specific programmes which could be implemented to enhance food security. Exchange rate and foreign exchange management policies, revolving funds, clearinghouse arrangements, and various insurance schemes are some of the mechanisms that may be examined.

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Appendix I. Research matrix for the AG. marketing and trade study.

Component/ Sub-component	General research question	Data source
SADCC/SOUTHERN AFRICA		
Trade	What have historical trade patterns been in major cereals and inputs for SADCC countries?	Trade matrices for grains: USDA,FAO,CSO's
	How have special trading arrangements for ag goods (countertrade, barter,etc.) evolved over time?	MOA, Min of Trade
	What are the main bilateral/multilateral trade agreements	Secondary documents
	What have been the effects of these agreements on intraregional trade in ag goods?	Interviews, secondary documents
Exchange Rate Policies	What exchange rate regimes are followed by the SADCC states?	IMF publications
	How has industrial country currency re-alignments affected foreign exchange (FOREX) fluctuations in SADCC countries?	IMF data on exchange rate movements
	How have these policies influenced ag producer incentives?	World Bank, IMF
Foreign Exchange	What is the foreign exchange situation in the SADCC countries?	Govt publications
	What are main sources of FOREX earnings?	World Bank, IMF,CSO
Food Aid	How has food aid dependency evolved over time?	Food aid data: WFP and IFPRI
	How have trilateral transactions evolved over time?	WFP and FAO, Trilateral evaluations
Production and Consumption	What are the historical food crop production/ consumption patterns?	Production data: FAO Food Balance Sheets
	How variable is production? How correlated are intercountry fluctuations?	Production database Koester

	What are projected production/consumption trends	SADCC reports
FOCUS COUNTRIES (ZIMBABWE, ZAMBIA, BOTSWANA)		
Food Consumption	Which foods are important elements of consumer expenditures in rural/urban areas?	HH Budget Survey CPI calculations
Food Prices	What are current/historical levels of food subsidies?	Parastatal accounts, other secondary data
	What are inflation rates for staple foods?	CPI
	What are seasonal retail market price patterns.	Retail price data: CSO, EWS
	Do domestic prices fluctuate more seasonally/ between years than world prices?	FAO Food Outlook,IMF exchange rate data
	Do comparison of import parity prices with actual prices reveal unsatisfied effective demand?	Retail and world prices, transport costs
Producer Prices	What are the historical patterns?	Official producer price, SER and CPI
	Has government price policy taxed/subsidised the ag sector/individual crops?	Official producer price, SER and CPI, parity prices
Inputs	What are typical production costs for major food/cash crops for commercial/small farms?	Crop budgets
	Which purchased inputs are most important for commercial/smallholder agriculture?	Crop budgets
	What has been the inflation rate?	MOA?
	What is the FOREX value of imported components?	MOA sources, industry documents
	Are official fertilizer prices harmonised across adjacent countries? Have cross-border leakages occurred?	MOA, input price indices
	What potential exists to expand input trade? -- Case study of Zimbabwe fertilizer, machinery, and seed?	Trader survey industry studies, interviews

	What are FOREX earnings of exported crops?	MOA, parastatal accounts, statistical yearbooks
	What administrative procedures are required to export/import?	Min of Trade, trader survey, parastatal interviews
	What are FOREX allocation procedures to import ag commodities/inputs	Min of Trade, central bank
Exchange Rate Policies (Zimbabwe)	How has devaluation affected inflation/budget deficit/the ag sector?	CSO, GMB, MOA, CFU
Foreign Exchange Management (Zimbabwe)	How is FOREX allocated?	Reserve Bank data and interviews
	Are allocations adequate/timely/predictable for ag sector?	Reserve Bank, trader survey, MOA
	How does system affect: -commercial farm income/employment levels; -producer/trader incentives; -sectoral resource flows; -composition of sector's exports/imports?	Min of Trade, MOA, trader survey, CSO, Reserve Bank, CFU
	What innovative arrangements exist to cope with the FOREX problem (revolving funds,etc.)? What are their relevance to food security?	MOA, Min of Trade, donors
Foreign Exchange Management (Zambia)	What were procedures for obtaining FOREX before/during/after the auction system?	Secondary documents, interviews
	Which sectors had FOREX allocations increased/ decreased during the auction?	Reserve Bank, CSO, Min. of Trade
	How did the auction affect the availability of ag goods?	Min of Trade, trader survey, secondary documents, interviews
	How did the auction affect food/ag input prices?	MOA, CSO-CPI

PARASTATAL MARKETING BOARD		
Parastatal Character-istics	What is the composition/volume of current operations?	Parastatal accounts
	What are procedures for govt approval of imports/exports/in-country sales/purchases?	Secondary documents, parastatal/trader surveys
	What are procedures for selecting private firms to participate in ag commodity import/export?	Secondary documents, parastatal/trader surveys
	What are major costs/subsidy levels by commodity?	Parastatal accounts, annual commodity reports
	How much do parastatals deal with other marketing boards in SADCC region? What problems occur?	Parastatal interviews
Trading Strategies	What are market information sources?	Parastatal/trader surveys
	What are major areas of risk? What risk reduction strategies are used?	Parastatal/trader surveys
	What are major barriers to more effective trading? How does the parastatal deal with them?	Parastatal/trader surveys
Trading Potential	What additional market information do parastatals need to improve performance?	Parastatal/trader surveys
	If major barriers were removed, what new trade potential would exist?	Parastatal/trader surveys
PRIVATE TRADERS		
Firm Character-istics	What is the current composition/volume of operations? Who are major clientele?	Trader survey, Min of Trade
	Who holds major firm ownership shares?	Trader survey, Chamber of Commerce
	Who are major competitors?	Trader survey, Chamber of Commerce
Trading Strategies	What are market information sources?	Trader surveys
	What are major risks? What risk reduction strategies are used?	Trader surveys

	What are major barriers? How do firms deal with them?	Trader surveys
Trading Potential	What additional market information do firms need to improve performance?	Trader surveys
	If major barriers were removed, what new potentials would exist?	Trader surveys